Abundance, Age, Sex and Size Statistics for Pacific Herring in the Togiak District of Bristol Bay, 2007

by

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Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	$(F, t, \chi^2, \text{etc.})$
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

The Pacific herring (*Clupea pallasi*) total run in the Togiak District of Bristol Bay was monitored for abundance/biomass and sampled for age, size, and sex composition in 2007. Abundance was estimated from aerial surveys with chartered aircraft. Commercial harvest was determined from fish tickets. Samples were collected from commercial purse seine and gillnet harvests. During closed fishing periods, herring samples were obtained from test fishing. The estimated 2007 total run biomass was 134,221 short tons. Total commercial harvest was 17,132 tons; 13,120 tons were harvested by the purse seine fishery and 4,012 tons by the gillnet fishery. Total exploitation rate was estimated to be 13.7%. A total of 2,879 herring were sampled for age, sex, length, weight and sexual maturity information from 11 May to 22 May. Herring ages varied from 4 to 20 years, with both purse seine and gillnet samples predominately age-9 and age-10. Mean length and weight from the purse seine fishery samples were 294 mm and 379 grams, while fish sampled from the gillnet fishery averaged 309 mm and 437 grams.

Key words: Pacific herring, *Clupea pallasi*, sac roe, abundance, spawning biomass, commercial herring fishery, Bristol Bay, Togiak District, age, length, weight, sex

INTRODUCTION

Each spring, Pacific herring (*Clupea pallasi*) migrate from their overwinter habitat south of the Pribilof Islands to spawning locations along the eastern Bering Sea coast from Norton Sound south to Port Moller (Figure 1). The Togiak District of Bristol Bay supports the largest discrete spawning biomass of Pacific herring in Alaskan waters. Biomass estimates based on aerial surveys have been conducted since 1978. Biomass peaked at 239,022 tons[1] (216,839 tonnes[2]) in 1979 and has averaged 139,152 tons (126,238 tonnes) from 1997 through 2006 (Table 1).

Herring spawn within the Togiak District from late April through early June. After spawning, herring leave the fishing district and migrate south in a clockwise direction along the Alaska Peninsula to feeding areas near Unalaska Island. In August and September, these fish move to over-wintering grounds near the Pribilof Islands (Shaboneev 1965; Rumyantsev and Darda 1970; Wespestad and Barton 1981; Funk 1990; Figure 1).

The largest commercial fishery for herring that spawn in the Togiak District occurs during their inshore spawning period. The most valuable product from this harvest is the ripened ovaries, or egg skeins, referred to as sac roe. This product is primarily marketed in Japan. Commercial harvest of herring for sac roe was first documented in the Togiak District in 1968. Passage of the Fisheries Conservation and Management Act in 1976 and the resulting inability of Japanese fishermen to harvest sac roe from U.S. waters prompted increased interest in the Togiak fishery by U.S. fisherman and is conducted using gillnets and purse seines. The 20-year mean sac roe harvest is presently 20,325 tons (18,439 tonnes) (Table 1). The greatest harvest of 30,315 tons (27,502 tonnes) occurred during the 1994 season (Table 1). The sac roe fishery herring spawn, deposited on brown algae *Fucus spp*, (rockweed), is also harvested within the Togiak District. This wild spawn-on-kelp product is harvested either by hand or by rake. The harvest, documented since 1967, has been intermittent in recent years because of low demand. No fishery occurred during the 1997, 1998, 2000, 2001, and 2004 to 2007 seasons.

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[1]   The Alaska Board of Fisheries requires that inseason catch and aerial survey biomass estimates be calculated and reported in short tons. The English short ton = 2,000 lb or 907.2 kg.

[2]   The metric tonne = 1,000 kg or 2,205 lbs: The conversion is tonnes (t) = tons/1.1023

During their post spawning migration, herring that spawn in Togiak District are susceptible to other fisheries. A directed food and bait fishery occurs during the mid-to-late summer months in the Unalaska Island area. Harvests were first documented on these feeding herring in 1929. Harvests reached a maximum of 3,006 tons (2,727 tonnes) in 1932. The fishery declined and ended completely by 1938 because of poor market demand, but was renewed in 1981. The annual food and bait harvest since 1987 has averaged 1,960 tons (1,778 tonnes; Table 1).

Incidental harvest of Togiak herring occurs as bycatch in fisheries targeting groundfish in the southeastern Bering Sea. Foreign vessels first exploited these ground fish fisheries but domestic fishermen have recently dominated. These fisheries often occur along the migratory route of feeding herring (Funk 1990; Rowell et al. 1991). The additional harvest upon a fully exploited herring population has been a concern brought before the North Pacific Fishery Management Council and the Alaska Board of Fisheries by western Alaskan fishermen.

Togiak herring have been managed as a single spawning population distinct from other populations in the Bering Sea. A maximum exploitation rate of 20% of the spawning biomass has been established by the Bristol Bay Herring Management Plan, 5 AAC 27.865. This plan provides a fixed allocation of 1,500 tons (1,361 tonnes) to the wild spawn-on-kelp fishery and of the remaining harvest, 7% is allocated to the Dutch Harbor food and bait fishery. The remainder of the harvestable surplus is reserved for the Togiak sac roe fishery with 30% allocated to the gillnet fishery and 70% to the purse seine fishery.

Stock assessment studies of the Togiak herring population began in 1976 and have continued annually since 1978 (McBride et al. 1981; McBride and Whitmore 1981; Fried et al. 1982–1984; Lebida et al. 1985a-b; Lebida 1987; Sandone and Brannian 1988; Lebida and Sandone 1990; Rowell et al. 1991; Rowell 1995, 2002a-b; West 2002; West et al. 2003; Schwanke 2003a-b; Brazil 2007a-c).

OBJECTIVES

The specific objectives of this data report were:

1) Estimate total inseason and postseason biomass of herring in the Togiak District based on aerial surveys;

2) Document the commercial harvest;

3) Characterize the Togiak herring harvest with respect to age, size (weight and length) and sexual composition by gear type;

4) Estimate the age class contributions to the total run biomass and commercial harvest for all observed age classes; and

5) Estimate the inseason and postseason exploitation rate of herring by gear type in the Togiak District.

METHODS

STUDY AREA

The Togiak District consists of all state waters between the longitude measured at the tip of Cape Constantine and the tip of Cape Newenham and extending south to the latitude of Cape Menshikof, an area of approximately 4,116 km^2 (1,200 nm^2) (Figure 2). Because of its large size,

the Togiak District is divided into 6 management sections: Kulukak, Nunavachak, Togiak, Hagemeister, Pyrite Point and Cape Newenham.

The Togiak District shoreline is characterized by a wide intertidal zone and several shallow bays. Diurnal tidal ranges reach 4.6 m (Selkregg 1976). The primary marine vegetation consists of ribbon kelp *Laminaria spp*, rockweed *Fucus spp,* and eelgrass *Zostera spp*. Rockweed is the most visible species of aquatic vegetation because it grows on cobble substrate in intertidal areas and upon rocky outcroppings. Herring have spawned throughout the fishing district, particularly in areas where eelgrass and rockweed are present.

AGE, SIZE AND SEX DATA

Data Collection

Pacific herring were collected from management sections within the fishing district during fishery openings and closures. Herring were sampled for each gear type and fishing section at the close of each commercial fishing period from processors, tenders, or individual fishing vessels. Attempts were made to collect samples from several vessels to ensure samples were collected from multiple schools of herring. During closed fishing periods, volunteer commercial fishermen made test purse seine sets to capture herring in order to sample the roe content as well as to gain age, sex and size information from the spawning biomass. Because of its presumed non-selective nature, purse seine gear was used for this sampling.

To determine age, a scale was removed from the left side of each fish approximately 2.5 cm behind the operculum and 2.5 cm below the lateral line. If scales were absent from this preferred area, a scale was removed from the right side of the fish in the same location, or anywhere a readable scale was present. Removed scales were dipped in 10% mucilage solution, mounted sculptured side up on glass slides, and read by annuli interpretation at low (~10x) magnification using a microfiche reader. Annuli interpretation was accomplished by counting the annuli formed at the end of winter prior to spawning (Shaboneev 1965). This timing was coincidental to the collection of samples in the spawning migration; thus, the outer edge of the scale was considered an annulus.

Standard length (tip of snout to the hypural plate) was measured to the nearest millimeter. Each herring was weighed to the nearest gram. Sex and maturity were determined for each herring by visual examination of the gonads, or gametes. Maturity of both male and female herring was rated by the eight-scale guideline outlined in Barton and Steinhoff (1980). These categories were combined and summarized as green (not ready to spawn), ripe (ready to spawn) or spent (already spawned).

Sample Sizes

Sample sizes were designed to ensure that the resulting age composition estimate of what is a multinomial population would result in a estimate whereby each age category would simultaneously fall within 5% (α =0.05) of the true population age proportions 90% of the time (Thompson 1987). A sample size of 400 herring provides this level of precision and accuracy. Sample sizes required to represent the biomass from test purse seines were 400 fish per strata. Samples were collected daily from each section where commercial purse seine and gill net fisheries occurred. We attempted to sample approximately 150 fish per day in each section from each fishery. Samples collected in adjacent sections and/or on successive days were combined such that there was a minimum of 400 fish in each time and area stratum. This was done

separately for samples collected from purse seine and gillnet fisheries. It should be noted that only the samples collected from the purse seine fishery were used to represent the biomass in any given area and time.

Age, Weight and Length Data

Age composition of the commercial harvest and biomass was estimated from herring collected from the commercial harvest and test fisheries throughout the Togiak District. The percent age composition by number, for each age class P_a, was estimated for each gear-time-area by:

$$P_a = \frac{n_a}{n}$$ (1)

where:

n_a = the number of herring in the sample that were age a and

n = the total number of herring in the sample.

Age composition of the commercial harvest and total run biomass were compared between area and time stratum.

Chi-square analysis was used to test for differences in age composition. Samples within and across area and time stratum were combined when they were not significant (> 0.05).

The mean weight-at-age, $\overline{W}_a$ for herring was estimated for each gear-time-area stratum by

$$\overline{W}_a = \frac{\sum_{i=1}^{n_a} W_{ai}}{n_a}$$ (2)

where:

W_{ai} = the individual weight of herring in sample n that were age a.

The mean length-at-age was calculated by substituting the individual length L_{ai} of herring in Equation 2 for the individual weight W_{ai}.

COMMERCIAL HARVEST

Fish tickets (sales receipts) were completed by processing companies and buyers for each commercial delivery of herring. Estimates of waste or discarded herring were obtained from aerial survey estimates of discarded herring or processor reports. Estimated waste was included in the fish ticket database and used in the calculation of exploitation rates.

BIOMASS ESTIMATION

Herring total run biomass for the Togiak District was estimated using aerial survey procedures outlined by Lebida and Whitmore (1985). Surveys were flown daily at low tide, weather

permitting. The Togiak herring commercial fishing district is divided into 13 aerial survey sections (Figure 3). Aerial survey estimates for each index area were summed to provide biomass estimates for each management section by day. Daily biomass estimates were then summed across management sections to provide an estimate of district wide biomass.

Age information from the herring samples collected by purse seine gear were pooled across management sections and tested using chi-square for temporal or spatial trends in age composition, which would indicate immigration of new herring or emigration of herring from the fishing district after spawning.

Age composition, by weight, of the commercial harvest and of the appropriate survey biomass data for each age class was estimated by

$$B_a = \left[\frac{n_a \overline{W}_a}{\sum_{a=1}^{\max_a} (n_a \overline{W}_a)} \right] B, \tag{3}$$

where:

B_a = the biomass for age a,

n_a = the number of herring in the sample that were age a,

$\overline{W}_a$ = the mean weight for herring of age a, and

B = the total estimated harvest expressed as biomass or daily biomass estimate.

Age composition of the waste, or deadloss (i.e., herring that were caught but not sold), was represented by the age composition for the same gear type in the commercial fishery.

The number of fish for each age class, N_a, was calculated by

$$N_a = \frac{B_a}{\overline{W}_a} \tag{4}$$

The total run biomass, B_{tot}, was calculated by summing the biomass of each age class and management section, B_i, from the selected daily aerial surveys.

$$B_{tot} = \sum_{i=1}^{2} B_i \tag{5}$$

where i = peak inseason biomass estimate (1) postseason biomass (2).

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The inshore escapement biomass, E_{tot}, was the summation of the difference between the run biomass, B_a, for each age and the combined purse seine and gillnet harvest for each age C_a:

$$E_{tot} = \sum_{a=1}^{max}(B_a - C_a)$$

(6)

An age structured analysis (ASA) model was used to forecast the 2007 total run. Historical total run biomass estimates are weighted in the model with the most recent estimate having the most influence. The last biomass estimate included in the model was from 2006.

RESULTS

BIOMASS ESTIMATE

Aerial surveys were flown in the Togiak District from 27 April to 4 June (Table 2; Figure 3). A total run biomass estimate of 134,221 tons (121,764 tonnes) was calculated by combining the peak inseason biomass estimate of 84,101 tons (76,296 tonnes) observed on 17 May and the postseason aerial survey estimate from 29 May of 50,120 tons (45,469 tonnes) (Table 2). These two surveys were combined to provide an overall estimate of the total biomass of herring in the Togiak District. The peak inseason estimate on 17 May was considered an estimate of the fish that were in the district during the fishery while the postseason estimate on 29 May was an estimate of herring in the district 12 days later. Based on our general understanding of herring spawning migrations in Togiak and elsewhere in the North Pacific, we believe that fish entering the Togiak spawning grounds will remain available for survey for about 7–10 days before migrating beyond our survey range. Therefore, survey estimates of biomass more than 10 days apart are believed to consist of unique fish.

Aerial survey conditions throughout the season were generally fair and ranged from poor to good. Aerial survey conditions were considered good on 17 May when the peak inseason biomass estimate was observed and fair during the postseason biomass estimate observed on 29 May (Table 2).

COMMERCIAL HARVEST

Commercial openings occurred from 10 May to 25 May (Table 3). A total harvest of 17,132 tons (15,542 tonnes) occurred within the Togiak District for sac roe product (Table 3). The first commercial opening was on 10 May when a harvest of 527 tons (478 tonnes) occurred with most of the harvest, 89.3%, from the Togiak and Pyrite Point Sections. On the final commercial opening, a total of 81 tons (74 tonnes) were harvested, with 100% of the catch coming from the Kulukak section. The daily harvest during the commercial fishery ranged from a low of 32 tons (29 tonnes) on 24 May, to a high of 2,610 tons (2,368 tonnes) on 12 May (Table 3).

Catches from Hagemeister Section accounted for 49.5% of the total commercial harvest, followed by the Kulukak (23.4%), Nunavachak (15.8%), Togiak (7.3%) and Pyrite Point (4.0%) sections (Table 3; Figure 4).

The total average roe percentage (weighted by catch) from all harvested herring was 10.4% (Table 3). The total roe percentage ranged from 9.3% to 12.3% during the commercial fishery and varied among sections.

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Purse Seine

There were ten commercial purse seine openings totaling 244 hours in the Togiak District from 10 May to 20 May (Table 3). A total of 13,120 tons (11,902 tonnes) was harvested, which included test fishing events and dead loss. The duration of purse seine openings averaged 24 h, with shortest opening occurring on 20 May (22 h) and the longest opening (30 h) on 10 May.

The first purse seine opening was on 10 May, with a harvest of 471 tons (427 tonnes) in the Togiak and Pyrite Point Sections. The largest purse seine harvest of 2,610 tons (2,368 tonnes) was on 12 May. The average daily commercial purse harvest was 1,272 tons (1,154 tonnes). Catches from Hagemeister Section accounted for 64.6% of the total purse seine harvest, followed by the Nunavachak (20.6%), Togiak (9.5%) and Pyrite Point (5.2%) sections (Table 3; Figure 5).

Roe accounted for 10% (by weight) of the purse seine harvested herring. The percentage of the biomass harvested as roe ranged from 8.0% to 12.6% and varied among sections with catches at Nunavachak yielding 9.2%, Togiak at 9.6%, and Hagemeister and Pyrite Point sections at 10.1% (Table 3).

Gillnet

There were 14 commercial gillnet openings totaling 336 hours from 10 May to 25 May, harvesting a total of 4,011 tons (3,639 tonnes) (Table 3).

The average daily commercial gillnet harvest was 287 tons (260 tonnes). The fishery peaked on 14 May, the third day of fishing, with a harvest of 593 tons (538 tonnes). The smallest commercial gillnet harvest of 32 tons (29 tonnes) occurred on 24 May (Table 3).

Catches from the Kulukak Section accounted for 100% of the total gillnet harvest (Table 3).

Roe accounted for 11.2% (by weight) from the commercial gillnet fishery. Roe percentage ranged from a low of 10.4% on 10 and 13 May, to a high of 12.3% on 22 May (Table 3).

Spawn on Kelp

There was no commercial harvest for this fishery in 2007 since no companies registered to buy herring spawn-on-kelp in 2007 (Table 1). The last spawn-on-kelp fishery occurred in 2002.

EXPLOITATION RATE

The inseason exploitation rate was estimated to be 20.4%, calculated by dividing the commercial sac roe harvest of 17,132 tons (15,542 tonnes) by the peak inseason biomass of 84,101 tons (76,296 tonnes) (Table 1 and 2). An estimated 117,089 tons (106,223 tonnes), representing 283 million herring, escaped harvest in the Togiak Fishery (Table 4).

The final postseason exploitation rate was estimated to be 13.7%, calculated by dividing the combined Togiak commercial sac roe and Dutch Harbor food and bait harvests by the total run biomass estimate of 134,221 tons (121,764 tonnes) (Table 1).

AGE, SIZE, AND SEX COMPOSITION

Commercial Harvest

The weighted age composition of the commercial harvest was calculated by combining the weighted age composition from the commercial purse seine and gillnet fishery (Table 4;

Appendix A1 and A2). The age composition of the commercial harvest by weight was predominately age-10 (27.2%), age-9 (23.3%), and age-6 (13.5%) (Table 4; Figure 6).

The mean length and weight of herring was calculated from non-selective commercial purse seine gear (11–20 May), and used to estimate the commercial harvest. The mean length of herring sampled was 294 mm and the mean weight was 379 g (Table 5; Appendix B1–B5). The sex composition of all aged samples collected from commercial purse seine, gillnet, and test fishing, was 49.6% male and 50.4% female and varied over time (Appendices B1–B7).

Purse Seine

Herring samples were collected from commercial purse seine openings occurring on 11–16 May and 18–20 May from the Hagemeister, Nunavachak, Pyrite Point, and Togiak Sections (Appendix B1–B5).

Herring sampled from the purse seine fishery ranged from age-4 to age-20 (Table 4). Age-6, -9 and -10 were the major age classes comprising 15.4%, 22.0% and 24.0%, of the commercial purse seine harvest by weight and 19.8%, 20.2%, and 19.9%, by number (Table 4; Figure 7; Appendix A1).

The mean length and weight of herring was calculated from commercial purse seine samples collected between 11–16 May and 18–20 May in the Hagemeister, Nunavachak, Pyrite Point, and Togiak Sections. The mean length of herring sampled from the purse seine harvest was 294 mm and mean weight was 379 g (Table 5; Appendix B1–B5.). The sex composition of all aged samples from the commercial purse seine fishery was 49.6% male and 50.4% female and varied over time (Appendix B5).

A total of 2,305 samples were collected from the commercial purse seine fishery (all sections) producing 2,033 readable scales (Table 6). A total of 1,070 samples were collected from 13–15 May and from 18–20 May in the Hagemeister Section, producing 945 (46.5%) of the total readable scales (Appendix B1). A total of 530 samples were collected from 12 and 14 May in the Nunavachak Section producing 465 (22.9%) of the total readable scales (Appendix B2). A total of 195 samples were collected from 16 and 19 May in the Pyrite Point Section producing 176 (8.7%) of the total readable scales (Appendix B3).

A total of 510 samples were collected from 11 and 13 May in the Togiak Section producing 447 (22.0%) of the total readable scales (Appendix B4).

Gillnet

Herring samples were collected from commercial gillnet openings occurring on 13 to 15 May and 18 May from the Kulukak Section (Appendix B6). A sample size of 404 was collected from the commercial gillnet fishery producing 344 readable scales (Table 6).

Herring sampled from the gillnet fishery ranged from age-6 to age-16 (Table 4), with age-9 and -10 fish representing 32.7% and 41.3%, of the commercial gillnet harvest by weight and 34.3%, and 39.5%, by number (Table 4; Figure 7; Appendix A2; Appendix B6). Herring age-11 and older composed 13.4% of the gillnet harvest by weight and 11.6% by number. The contribution of herring age-8 and younger was 12.6% by weight and 14.5% by number (Table 4; Figure 7; Appendix A2).

Mean length of herring sampled from the commercial gillnet harvest was 309 mm and mean weight was 437 g (Table 5; Appendix B6). The sex composition of all aged samples from the gillnet fishery was 48.0% male and 52.0% female (Appendix B6).

Test Fishing

Herring samples were collected during a test fishing event on 22 May from the Togiak Section (Appendix B7).

Herring sampled on 22 May from test fishing ranged from age-5 to age-14. Age-9 and -10 (37.6%), as well as age-5 and -6 (34.9%) herring were the major age classes comprising 72.5% of all herring sampled from test fishing (Appendix B7).

The mean length of herring sampled from test fishing sets was 290 mm and the mean weight was 306 g (Appendix B7). While the sex composition varied over time, the combined sex composition for all aged samples from test fishing was 48.3% male and 51.7% female (Appendix B7).

A sample size of 170 was collected from test fishing sets which produced 149 readable scales (Table 6).

AGE COMPOSITION OF POPULATION

Samples used to estimate the inseason peak biomass age composition were collected from individual sections (Appendix B8). Samples collected with non-selective purse seine gear from the Nunavachak (12 and 14 May) Section, were applied to the aerial survey biomass estimate of 18,206 tons (16,516 tonnes) observed 17 May in the Nunavachak and Kulukak Sections. Samples collected with non-selective gear from the Togiak section, 11–13 May, were applied to the aerial survey biomass estimate of 59,964 tons (54,399 tonnes) observed 17 May in the Togiak Section. Samples collected from the Hagemeister, 13–16 May, and Pyrite Point, 16 May, Sections, were applied to the aerial survey biomass estimate of 5,931 tons (5,381 tonnes) observed 17 May in the Hagemeister Section.

The age composition of the inseason biomass estimate by weight was dominated by age-10 (24.3%), age-9 (23.6%), and age-6 (14.5%) herring (Table 4). Biological information was collected from 2,305 herring caught by commercial purse seiners in the Togiak District from 11 May to 20 May 2007 (Table 6; Appendices B1–B5). The age composition of herring samples collected with purse seine gear from 11 May to 20 May was used to estimate the age composition of the inseason peak biomass on 17 May and the postseason peak biomass on 29 May (Table 4).

The mean length of herring in the inseason peak biomass estimate was 296 mm with a mean weight of 389 g (Table 5; Appendix B8.). The sex composition of the inseason peak biomass estimate was 48.5% male and 51.5% female (Appendix B8). The mean length and weight of herring was calculated from non-selective commercial purse seine gear between 11–16 May and used to estimate the inseason biomass.

Due to the lack of a postseason sampling program, samples collected with non-selective gear from Hagemeister (18–20 May), and Pyrite Point (19 May) Sections were combined to estimate the age composition of the postseason peak biomass observed on 29 May. Test fish samples collected from the Pyrite Point Section on 22 May were not applied to the postseason peak biomass observed on 29 May, as a large proportion of the sample was spawned out. Age composition of the postseason peak biomass estimate by weight was dominated by age-10 (22.9%), age-6 (18.9%), and age-9 (16.1%) herring (Table 4; Appendix B9.). The mean length of herring in the postseason peak biomass estimate was 288 mm and mean weight was 344 g (Appendix B9).

DISCUSSION

The purpose of this report was to estimate the total run biomass, spawning escapement, and age, size (weight and length) and sex composition of herring in the Togiak District. The 2007 sampling was organized differently than in years past, with the sampling crew located in Dillingham instead of at the major processor. This strategy proved successful in providing inseason age composition estimates to area managers in a timely manner at a reduced cost.

The 2007 total run biomass estimate (Objective 1) of 134,221 tons (121,764 tonnes) was just below the 20 year average (Table 1). The estimated spawning escapement of 117,089 tons (106,223 tonnes) represents an estimated 283 million herring.

The total commercial harvest (Objective 2) of 17,132 tons (15,542 tonnes) was the seventh lowest in the last 20 years and was also less than the 20 year average of 20,325 tons (18,439 tonnes) (Table 7). The commercial fishery started on 10 May, which was the fifth latest starting date in the last 20 years. The late start to the fishery can be attributed to a colder than normal spring. The average roe percent was 10% for all harvested herring.

The duration of the 2007 gillnet and purse seine commercial fishery was the longest in the last 20 years. The peak aerial survey count of vessels on the Togiak District herring grounds, gillnet and purse seine was the lowest in the last 20 years. This may be a result of market conditions and fishermen and processors forming co-ops in 2001 to ensure quality in the harvest. This practice allows the purse seine fishermen to inspect their catches more closely, and harvest only the most valuable fish. The long duration of the 2007 fishery was also a function of historically (20 year) low processing capacity and effort.

The commercial purse seine harvest of 13,120 tons (11,902 tonnes) of herring was 13.2% below the 20 year average of 15,116 tons (13,713 tonnes). The average roe percentage (10.0%) of this fishery was the third highest roe percentage in the last 20 years.

The commercial gillnet harvest of 4,012 tons (3,640 tonnes) was 22.1% below the 20 year average of 5,149 tons (5,676 tonnes). The average roe percentage (11.2%) was above the 20 year average of 10.4% and the sixth highest recorded during the same time period.

Sampling effort aimed at estimating the age, size (weight and length), and sex composition of the herring harvest was less than that of previous years, but was considered adequate and representative of the population (Objective 3). The number of readable scales (2,033) collected from the 2007 commercial purse seine fishery was less than the 3,773 readable scales collected in 2006 and less than the 4,549 readable scales collected on average since 2000 (Brazil 2007a, 2007b, 2007c, Schwanke 2003a, 2003b, West et al. 2003). The number of readable scales (344) collected from the commercial gillnet fishery was less than the 659 collected in 2006 and less than the 983 readable scales collected on average since 2000 (Brazil 2007a-c, Schwanke 2003a-b, West et al. 2003). The number of readable scales (149) collected from test fishing in 2007 was less than the previous year and less than the 2000's average of 817 readable scales.

One reason for the drop in sampling effort was that in 2007 sampling was conducted in Dillingham on fish collected from the fishery in Togiak and transported to Dillingham. This created a logistical hurdle that needed to be overcome. However, with our better understanding of the logistics required, the drop in sampling effort experienced in 2007 should be temporary as the new sampling regime is further refined.

We effectively estimated the age class contributions to the total 2007 run biomass and commercial herring harvested in Togiak (Objective 4). The total run biomass in 2007 was dominated by age-10 (24.3%), age-9 (23.6%) and age-6 (14.5%) herring (Table 4). The commercial purse seine fishery in 2007 was dominated by age-9 (20.2%), age-10 (19.8%), and age-6 (19.7%) herring (Table 5). Aged samples from the commercial gillnet fishery were dominated by age-10 (39.5%) and age-9 (34.3%) herring (Table 5).

The shift in age composition from older to younger herring that typically occurs throughout the fishery was not as pronounced in 2007. This was most likely due to the large number of younger herring observed early in the fishery. Age-5 and age-6 fish comprised over 20% of the herring when the fishery began (10–12 May) and increased to over 40% by the end of the fishery (18–20 May) (Appendix A1). The large return of age-5 and age-6 fish observed in the fishery suggests strong recruitment in the future. Large recruitment events have been observed approximately every eight to ten years in the Togiak fishery (Figure 8).

One problem with estimating the true strength of recruitment in any given year is the lack of postseason age composition sampling. In 2007 this precluded an age contribution estimate for the fish observed on the 29 May aerial survey. The younger recruit age classes, age-4 and age-5 herring, generally spawn later than older fish and therefore are typically underrepresented when postseason sampling is not conducted.

The 2007 inseason exploitation rate (Objective 5) of 20.3% (Table 1 and 2) was higher than last year's rate of 19.2% (Brazil 2007c). The postseason exploitation rate of 13.7% (Table 1) was less than the 14.1% in 2006 and less than the 20 year average (Table 1).

A total of 18.9 mi (linear miles) of spawning herring was observed in 2007, which was slightly greater than that observed in 2006 (Table 8). Herring spawn was first documented and peaked on 13 May when 11.9 mi were observed (Table 2). This was lower than the recent 10 year average (46.0 mi) and the second lowest in the last 20 years. The lower than expected herring spawn may be a function of one or more of the following: (1) aerial survey conditions were better in previous years, (2) herring may have spawned deeper, or (3) spawning was obscured by turbid water, making observations more difficult.

ACKNOWLEDGEMENTS

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TABLES AND FIGURES

Table 1.–Historical total run biomass and commercial harvest (tons) of Pacific herring returning to the Togiak District, Bristol Bay, 1987–2007.

Year	Togiak Total Run Biomass (tons)	Togiak Sac Roe Harvest (tons)	Spawn-on-Kelp Harvest (lbs)	Spawn-on-Kelp Harvest (tons)	Spawn-on-Kelp Herring Equivalent (tons)	Dutch Harbor Food and Bait Harvest (tons)	Exploitation Rate
1987	88,398	15,530	307,307	154	1,309	2,503	21.9%
1988	134,718	14,168	489,400	245	1,782	2,004	13.3%
1989	98,965	12,259	559,754	280	2,499	3,081	18.0%
1990	88,105	12,230	413,844	207	1,617	820	16.6%
1991	83,229	14,970	348,357	174	1,310	1,325	21.2%
1992	156,957	25,808	363,600	182	1,482	1,949	18.6%
1993	193,847	17,956	383,000	192	1,481	2,790	11.5%
1994	185,412	30,315	308,400	154	1,134	3,349	18.8%
1995	149,093 [a]	26,732	281,600	141	996	1,748	19.8%
1996	135,585 [a]	24,871	455,800	228	1,899	2,239	21.4%
1997	144,887	23,813				1,950	17.8%
1998	121,000 [a]	22,776				1,994	20.5%
1999	157,028	19,878	419,563	210	1,605	2,398	15.2%
2000	130,904 [a]	20,421				2,014	17.1%
2001	115,155	22,330				1,439	20.6%
2002	120,196 [a]	17,049	67,793	34	260	2,751	16.7%
2003	126,213 [a]	21,663				1,487	18.3%
2004	143,124 [a]	18,868				1,258	14.1%
2005	156,727	20,912				1,154	14.1%
2006	176,288	23,953				953	14.1%
2007	134,221	17,132				1,214	13.7%
1987-2006 Mean	135,292	20,325	366,535	183	1,448	1,960	17.5%
1997-2006 Mean	139,152	21,166	243,678	122	933	1,740	16.9%

Note: Blank cells indicate no fishery occurred that year.

Source: 1987 (Sandone and Brannian 1988); 1988-2007 (ADF&G fish tickets).

[a] Total biomass estimate was based on preseason forecast because inseason biomass could not be estimated due to poor aerial survey conditions during the season.

Table 2.–Aerial survey estimates (tons) of herring by index area, Togiak District, 2007.

Date	Survey Rating[b]	Miles of Spawn	Estimated Biomass by Index Area [a]													Daily Total[c]
			NUS	KUK	MET	NVK	UGL	TOG	TNG	MTG	OSK	PYR	CPN	HAG	WAL	
4/27	3.6															
4/29	3.8															
5/02	2.7															
5/04	3.2															
5/06	3.6			68												68
5/07	4.1			16												16
5/09	3.4			288		147		11191						66		11,692
5/10	3.9			1,247			22	16,644								17,913
5/13	2.4	11.9	740	3,395	1,640	2,195	3,919	41,955	16,732	5,906	3,567					80,049
5/15	3.0	1.4	121	5,934	1,417	1,828	1,286	46,356	3,751	3,584	14,141	830	137			79,385
5/16	d	1.5														0
5/17	2.2	2.7		5,350	5,689	158	7,009	59,964	3,411	1,222	1,298					84,101
5/20	3.9						531	71,517	5,790	748	125					78,711
5/29	2.9	1.4	724	1,119	1,982	1,760	498	43,161	306	570						50,120
6/04	3.0		127	641	12	429		16,612	121							17,942
Mean	3.3															
Total		18.9												Peak Biomass		84,101

[a] Index areas: NUS - Nushagak Peninsula; KUK - Kulukak; MET - Metervik; NVK - Nunavachak; UGL - Ungalikthluk/Togiak; TOG - Togiak; TNG - Tongue Pt; MTG - Matogak; OSK - Osvisak; PYT - Pyrite Point; CPN - Cape Newenham; HAG - Hagemeister; WAL – Walrus Islands.

[b] 1= Excellent, 2 = Good, 3 = Fair, 4 = Poor, 5 = Unsatisfactory.

[c] The 2007 Togiak District Pacific herring biomass was estimated at 134,221 (tons). This is the sum of:
   1) Peak biomass aerial survey estimate of 84,101 (tons) observed 17 May.
   2) Aerial biomass estimates of 50,120 (tons) observed 29 May.

[d] Vessel count and spawn survey only.

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Table 3.–Commercial herring harvest (tons) by fishing section, gear type, Togiak District, Bristol Bay, 2007.

Date	Duration (hrs)	Periods	Kulukak Tons	Roe %	Nunavachak Tons	Roe %	Togiak Tons[a]	Roe %	Hagemeister Tons	Roe %	Pyrite Point Tons	Roe %	Cape Newenham Tons	Roe %	Total[b] Tons	Roe %
							Purse Seine									
10-May	30	1			0.0	0.0	296.3	9.3	0.0	0.0	174.4	9.5	0.0	0.0	471	9.4
12-May	24	2			2,232.5	9.2	298.0	9.6	79.3	10.6	0.0	0.0	0.0	0.0	2,610	9.3
13-May	24	3			320.4 [c]		258.5	9.8	1,062.1	10.6	0.0	0.0	0.0	0.0	1,641	10.4
14-May	24	4			149.8	9.4	0.0	0.0	437.6	10.2	0.0	0.0	0.0	0.0	587	8.0
15-May	24	5			0.0	0.0	0.0	0.0	1,224.3	10.0	0.0	0.0	0.0	0.0	1,224	12.6
16-May	24	6			0.0	0.0	0.0	0.0	858.1	9.5	374.3	10.7	0.0	0.0	1,232	9.9
17-May	24	7			0.0	0.0	0.0	0.0	833.8	10.3	0.0	0.0	0.0	0.0	834	10.3
18-May	24	8			0.0	0.0	0.0	0.0	1,650.0	10.1	0.0	0.0	0.0	0.0	1,650	10.1
19-May	24	9			0.0	0.0	0.0	0.0	880.1	10.2	139.2	9.3	0.0	0.0	1,019	10.1
20-May	22	10			0.0	0.0	0.0	0.0	1,451.2	9.7	0.0	0.0	0.0	0.0	1,451	9.7
22-May							340.0								340	
23-May							60.0								60	
Subtotal	244				2,702.7	9.2	1,252.8	9.6	8,476.5	10.1	687.9	10.1	0.0	0.0	13,120	10.0
							Gillnet									
10-May	24	1	56.2	10.4											56	10.4
13-May	24	2	334.8	10.4											335	10.4
14-May	24	3	593.3	11.0											593	11.0
15-May	24	4	459.1	11.3											459	11.3
16-May	24	5	396.5	11.8											397	11.8
17-May	24	6	275.0	11.1											275	11.1
18-May	24	7	424.6	11.1											425	11.1
19-May	24	8	438.6	10.8											439	10.8
20-May	24	9	222.3	11.0											222	11.0
21-May	24	10	435.7	11.4											436	11.4
22-May	24	11	135.7	12.3											136	12.3
23-May	24	12	125.5	11.8											126	11.8
24-May	24	13	32.4	11.7											32	11.7
25-May	24	14	81.3	11.6											81	11.6
Subtotal	336		4,011.0	11.2											4,011	11.2

-continued-

Table 3.–Page 2 of 2.

Date	Duration	Periods	Kulukak		Nunavachak		Togiak		Hagemeister		Pyrite Point		Cape Newenham		Total[b]	
			Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %
							Combined									
10-May			56.2	10.4	0.0	0.0	296.3	9.3	0.0	0.0	174.4	9.5	0.0	0.0	527	9.4
12-May			0.0	0.0	2,232.5	9.2	298.0	9.6	79.3	10.6	0.0	0.0	0.0	0.0	2,610	9.3
13-May			334.8	10.4	320.4 [c]	0.0	258.5	9.8	1,062.1	10.6	0.0	0.0	0.0	0.0	1,976	10.4
14-May			593.3	11.0	149.8	9.4	0.0	0.0	437.6	10.2	0.0	0.0	0.0	0.0	1,181	10.5
15-May			459.1	11.3	0.0	0.0	0.0	0.0	1,224.3	10.0	0.0	0.0	0.0	0.0	1,683	12.2
16-May			396.5	11.8	0.0	0.0	0.0	0.0	858.1	9.5	374.3	10.7	0.0	0.0	1,629	10.3
17-May			275.0	11.1	0.0	0.0	0.0	0.0	833.8	10.3	0.0	0.0	0.0	0.0	1,109	10.5
18-May			424.6	11.1	0.0	0.0	0.0	0.0	1,650.0	10.1	0.0	0.0	0.0	0.0	2,075	10.3
19-May			438.6	10.8	0.0	0.0	0.0	0.0	880.1	10.2	139.2	9.3	0.0	0.0	1,458	10.3
20-May			222.3	11.0	0.0	0.0	0.0	0.0	1,451.2	9.7	0.0	0.0	0.0	0.0	1,674	9.9
21-May			435.7	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	436	11.4
22-May			135.7	12.3	0.0	0.0	340.0	0.0 [a]	0.0	0.0	0.0	0.0	0.0	0.0	476	12.3
23-May			125.5	11.8	0.0	0.0	60.0	0.0 [a]	0.0	0.0	0.0	0.0	0.0	0.0	186	11.8
24-May			32.4	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32	11.7
25-May			81.3	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81	11.6
Total			4,011.0	11.2	2,702.7	9.2 [c]	1,252.8	9.6 [a]	8,476.5	10.1 [a]	687.9	10.1	0.0	0.0	17,132	10.4

[a] Includes test fish harvest which is conducted during closed commercial periods.
[b] Includes food and bait harvest.
[c] Documented waste.

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Table 4.–Estimated age composition of the harvest by gear type, spawning run (inseason and postseason) and escapement in terms of both total biomass and estimated numbers of fish from the herring sac roe fishery, Togiak District, 2007.

| | Purse Seine | | | | | Gillnet | | | | | Total Harvest | | | |
| | Biomass | | Herring | | | Biomass | | Herring | | | Biomass | | Herring | |
Age	ST	%	(x 1,000)	‰o	Age	ST	%t	(x 1,000)	%	Age	ST	%	(x 1,000)	%
1	0	0.0	0	0.0	1	0	0.0	0	0.0	1	0	0.0	0	0.0
2	0	0.0	0	0.0	2	0	0.0	0	0.0	2	0	0.0	0	0.0
3	0	0.0	0	0.0	3	0	0.0	0	0.0	3	0	0.0	0	0.0
4	129	0.7	652	1.6	4	0	0.0	0	0.0	4	129	0.8	652	1.6
5	1,233	7.3	4,750	11.6	5	0	0.0	0	0.0	5	1,233	7.2	4,750	11.6
6	2,235	15.4	6,925	19.8	6	80	2.0	218	2.6	6	2,315	13.5	7,143	17.5
7	662	5.5	1,821	6.2	7	86	2.1	218	2.6	7	748	4.4	2,039	5.0
8	1,250	9.4	2,981	9.2	8	338	8.4	775	9.3	8	1,589	9.3	3,756	9.2
9	2,672	22.0	5,881	20.2	9	1,313	32.7	2,859	34.3	9	3,985	23.3	8,740	21.4
10	3,012	24.0	6,021	19.9	10	1,655	41.3	3,295	39.5	10	4,668	27.2	9,316	22.8
11	985	7.9	1,832	6.1	11	272	6.8	509	6.1	11	1,256	7.3	2,341	5.7
12	493	4.1	844	3.0	12	197	4.9	339	4.1	12	690	4.0	1,183	2.9
13	104	0.8	176	0.6	13	13	0.3	24	0.3	13	118	0.7	201	0.5
14	216	1.4	359	1.0	14	46	1.2	73	0.9	14	262	1.5	432	1.1
15	68	0.7	112	0.5	15	0	0.0	0	0.0	15	68	0.4	112	0.3
16	20	0.2	29	0.1	16	11	0.3	24	0.3	16	31	0.2	53	0.1
17	24	0.1	42	0.1	17	0	0.0	0	0.0	17	24	0.1	42	0.1
18	14	0.1	23	0.1	18	0	0.0	0	0.0	18	14	0.1	23	0.1
19	0	0.0	0	0.0	19	0	0.0	0	0.0	19	0	0.0	0	0.0
20	3	0.1	4	0.0	20	0	0.0	0	0.0	20	3	0.0	4	0.0
Total	13,120	100	32,452	100	Total	4,012	100	8,334	100	Total	17,132	100	40,786	100

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Table 4.–Page 2 of 3.

	Inseason					Postseason					Total Run			
	Biomass		Herring			Biomass		Herring			Biomass		Herring	
Age	ST	by Wt	(x 1,000)	by No.	Age	ST	by Wt	(x 1,000)	by No.	Age	ST	by Wt	(x 1,000)	by No.
1	0	0.0	0	0.0	1	0	0.0	0	0.0	1	0	0.0	0	0.0
2	0	0.0	0	0.0	2	0	0.0	0	0.0	2	0	0.0	0	0.0
3	0	0.0	0	0.0	3	0	0.0	0	0.0	3	0	0.0	0	0.0
4	371	0.5	1,920	1.1	4	816	1.6	4,209	3.2	4	1,186	0.7	6,128	1.6
5	3,943	5.5	14,779	8.9	5	6,872	13.7	26,937	20.4	5	10,815	7.3	41,716	11.6
6	10,376	14.5	31,585	18.8	6	9,484	18.9	30,304	22.9	6	19,860	15.5	61,889	19.8
7	5,323	5.9	14,661	6.9	7	1,914	3.8	5,331	4.0	7	7,237	5.5	19,993	6.2
8	7,999	9.4	18,556	9.4	8	4,717	9.4	11,504	8.7	8	12,716	9.4	30,061	9.2
9	20,502	23.6	44,383	22.2	9	8,050	16.1	17,958	13.6	9	28,552	22.0	62,341	20.2
10	20,691	24.3	40,539	20.5	10	11,493	22.9	23,570	17.8	10	32,184	24.0	64,109	19.9
11	7,549	8.0	13,595	6.3	11	3,821	7.6	7,295	5.5	11	11,370	7.9	20,890	6.1
12	4,188	4.5	6,841	3.3	12	1,336	2.7	2,245	1.7	12	5,524	4.1	9,086	3.0
13	904	0.9	1,483	0.6	13	339	0.7	561	0.4	13	1,243	0.8	2,044	0.6
14	1,296	1.3	1,988	0.9	14	968	1.9	1,684	1.3	14	2,264	1.4	3,671	1.0
15	391	0.8	615	0.6	15	154	0.3	281	0.2	15	546	0.7	896	0.5
16	343	0.3	483	0.2	16	0	0.0	0	0.0	16	343	0.2	483	0.1
17	190	0.1	304	0.1	17	157	0.3	281	0.2	17	347	0.1	585	0.1
18	26	0.2	44	0.1	18	0	0.0	0	0.0	18	26	0.1	44	0.1
19	0	0.0	0	0.0	19	0	0.0	0	0.0	19	0	0.0	0	0.0
20	9	0.1	22	0.1	20	0	0.0	0	0.0	20	9	0.0	22	0.0
Total	84,101	100	191,797	100	Total	50,120	100	132,160	100	Total	134,221	100	323,956	100

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Table 4.–Page 2 of 3.

	Escapement			
	Biomass		Herring	
Age	ST	by Wt	(x 1,000)	by No.
1	0	0.0	0	0.0
2	0	0.0	0	0.0
3	0	0.0	0	0.0
4	1,058	0.9	5,477	1.9
5	9,582	8.2	36,966	13.1
6	17,545	15.0	54,746	19.3
7	6,489	5.5	17,954	6.3
8	11,127	9.5	26,304	9.3
9	24,566	21.0	53,601	18.9
10	27,516	23.5	54,792	19.3
11	10,114	8.6	18,549	6.6
12	4,834	4.1	7,903	2.8
13	1,126	1.0	1,844	0.7
14	2,001	1.7	3,239	1.1
15	478	0.4	784	0.3
16	311	0.3	430	0.2
17	323	0.3	542	0.2
18	12	0.0	21	0.0
19	0	0.0	0	0.0
20	6	0.0	18	0.0
Total	117,089	100	283,170	100

Table 5.–Mean length (mm), weight (g), and standard deviation by age for herring of the commercial harvest by gear type, Togiak District, 2007.

	Inseason Biomass[a]						Commercial Purse Seine						Commercial Gillnet				
Age	Number of Samples	Mean Length (mm)	SD	Mean Weight (g)	SD	Age	Number of Samples	Mean Length (mm)	SD	Mean Weight (g)	SD	Age	Number of Samples	Mean Length (mm)	SD	Mean Weight (g)	SD
4	17	239	7.7	183	24.8	4	32	238	8.3	180	23.1	4					
5	139	257	9.5	242	30.8	5	235	257	9.5	238	31.9	5					
6	294	274	7.8	300	31.9	6	402	274	7.9	296	33.2	6	9	279	5.5	333	25.9
7	108	284	7.7	332	37.1	7	127	284	7.5	331	36.2	7	9	289	8.3	359	24.7
8	147	296	6.1	386	37.2	8	188	296	6.1	383	37.9	8	32	299	5.6	396	27.0
9	347	303	5.3	414	37.7	9	411	303	5.2	413	38.2	9	118	305	5.8	417	32.8
10	320	314	6.6	461	45.9	10	404	314	6.5	457	46.6	10	136	315	6.0	456	44.0
11	98	321	7.2	498	49.6	11	124	321	6.9	493	48.4	11	21	321	6.0	484	41.1
12	52	330	7.4	528	60.7	12	60	330	7.4	529	62.0	12	14	332	9.4	526	57.7
13	10	330	6.9	539	46.1	13	12	330	6.4	541	43.4	13	1	333		499	
14	14	335	9.3	573	45.6	14	20	334	8.5	557	56.3	14	3	332	10.3	576	61.1
15	9	336	7.6	549	47.6	15	10	336	7.2	544	47.6	15					
16	3	350	10.7	623	41.0	16	3	350	10.7	623	41.0	16	1	313		422	
17	1	338		568		17	2	338	0.7	538	42.4	17					
18	2	341	6.4	530	26.2	18	2	341	6.4	530	26.2	18					
19						19						19					
20	1	338		592		20	1	338		592		20					
Total	1,562	296	22.7	389	95		2,033	294	23.8	379	98.5		344	309	11.6	437	54.7

[a] Collected from non-selective gear, commercial purse seine.

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Table 6.–Number of samples collected by gear type, Togiak District, 2007.

Gear Type	Readable Scale Samples	Unreadable Scale Samples	Total	Percent Unreadable Scale Samples
Commercial Purse Seine	2,033	272	2,305	11.8
Commercial Gillnet	344	60	404	14.9
Test Purse Seine	149	21	170	12.4
Total	2,526	353	2,879	12.3

Table 7.–Sac roe herring industry participation, fishing effort and harvest, Togiak District 1987-2007.

Year	Number of Buyers	Daily Processing Capacity[a]	Fishery Dates	Gillnet					Purse Seine					Total Harvest[c]
				Effort[b]	Duration (hours)	Harvest[c]	CPUE	Roe %	Effort[b]	Duration (hours)	Harvest[c]	CPUE	Roe %[d]	
1987	18		4/27-5/6	148	36.0	2,685	0.5	8.6	111	5.5	12,845	21.0	8.9	15,530
1988	22		5/17	300	4.0	3,695	3.1	8.3	239	0.5	10,472	87.6	10.9	14,167
1989	19		5/9-5/14	320	5.0	2,844	1.8	7.8	310	3.0	9,415	10.1	8.5	12,259
1990	16	3,100	5/8-5/20	277	66.0	3,072	0.2	9.0	221	3.0	9,158	13.8	9.7	12,230
1991	16	3,350	5/10-5/17	170	14.0	3,182	1.3	8.5	200	3.0	11,788	19.6	10.0	14,970
1992	18	3,700	5/20-5/27	274	25.5	5,030	0.7	8.8	301	0.3	20,778	230.1	9.2	25,808
1993	12	2,500	4/27-5/9	75	144.5	3,564	0.3	10.1	140	33.8	14,392	3.0	9.6	17,956
1994	16	3,300	5/11-5/20	146	76.0	7,462	0.7	12.0	240	4.6	22,853	20.7	9.4	30,315
1995	22	4,350	5/7-5/15	250	33.5	6,995	0.8	12.0	254	12.2	19,737	6.4	10.1	26,732
1996	19	4,850	5/3-5/8	461	18.0	6,863	0.8	11.1	268	2.4	18,008	27.8	9.0	24,871
1997	18	4,200	5/2-5/6	336	24.0	5,164	0.6	11.8	231	6.4	18,649	12.6	9.4	23,813
1998	15	2,475	4/29-5/10	152	46.0	5,952	0.9	12.5	123	16.5	16,824	8.3	9.6	22,776
1999	12	2,400	5/18-5/26	171	28.0	4,858	1.0	11.5	96	4.7	15,020	33.3	9.2	19,878
2000	12	2,100	5/6-5/14	227	67.0	5,464	0.4	10.6	90	15.8	14,957	10.6	10.1	20,421
2001	11	2,255	5/6-5/13	96	84.0	6,481	0.8	10.6	64	26.0	15,849	9.5	9.2	22,330
2002	8	1,920	5/3-5/13	82	102.0	5,216	0.6	10.9	37	57.5	11,833	5.6	9.3	17,049
2003	7	1,920	4/25-5/7	75	142.0	6,505	0.6	10.9	35	110.2	15,158	3.9	8.9	21,663
2004	6	2,150	4/29-5/9	54	162.0	4,980	0.6	10.4	31	78.0	13,888	5.7	9.5	18,868
2005	8	2,330	4/30-5/8	56	149.0	5,841	0.7	11.2	33	83.0	15,071	5.5	9.6	20,912
2006	7	2,060	5/12-5/21	49	143.9	7,132	1.0	10.8	28	113.0	16,821	5.3	9.2	23,953
2007	5	1,420	5/10-5/25	25	366.0	4,012	0.4	11.2	21	244.0	13,120	2.6	10.0	17,132
1987-2006 Average	14	2,880		186	68.5	5,149	0.9	10.4	153	29.0	15,176	27.0	9.5	20,325
1997-2006 Average	10	2,381		130	94.8	5,759	0.7	11.1	77	51.1	15,407	10.0	9.4	21,166

[a]   Number of tons per day based on companies registered.

[b]   Peak aerial survey count.

[c]   Harvest total includes deadloss and test fish harvest.

[d]   Values in 2002 and 2003 are lower than inseason assessment due to more stringent postseason market scrutiny compared with previous years.

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Table 8.–Total discrete spawning observations made during all aerial surveys and total linear miles of coastline utilized by spawning herring for deposition, Togiak District 1987–2007.

Year	Spawn Estimates	
	Observations	Miles
1987	160.0	75.8
1988	107.0	61.1
1989	69.0	52.5
1990	94.0	65.7
1991	90.0	69.5
1992	160.0	96.9
1993	76.0	53.4
1994	80.0	71.9
1995	70.0	58.7
1996	99.0	72.9
1997	79.0	59.1
1998	42.0	33.0
1999	33.0	56.0
2000	71.0	46.0
2001	100.0	57.0
2002	79.0	32.0
2003	182.0	94.7
2004	47.0	36.4
2005	106.0	27.6
2006	66.0	17.8
2007	43.0	18.9
1987-06 Average	90.5	56.9
1997-06 Average	80.5	46.0
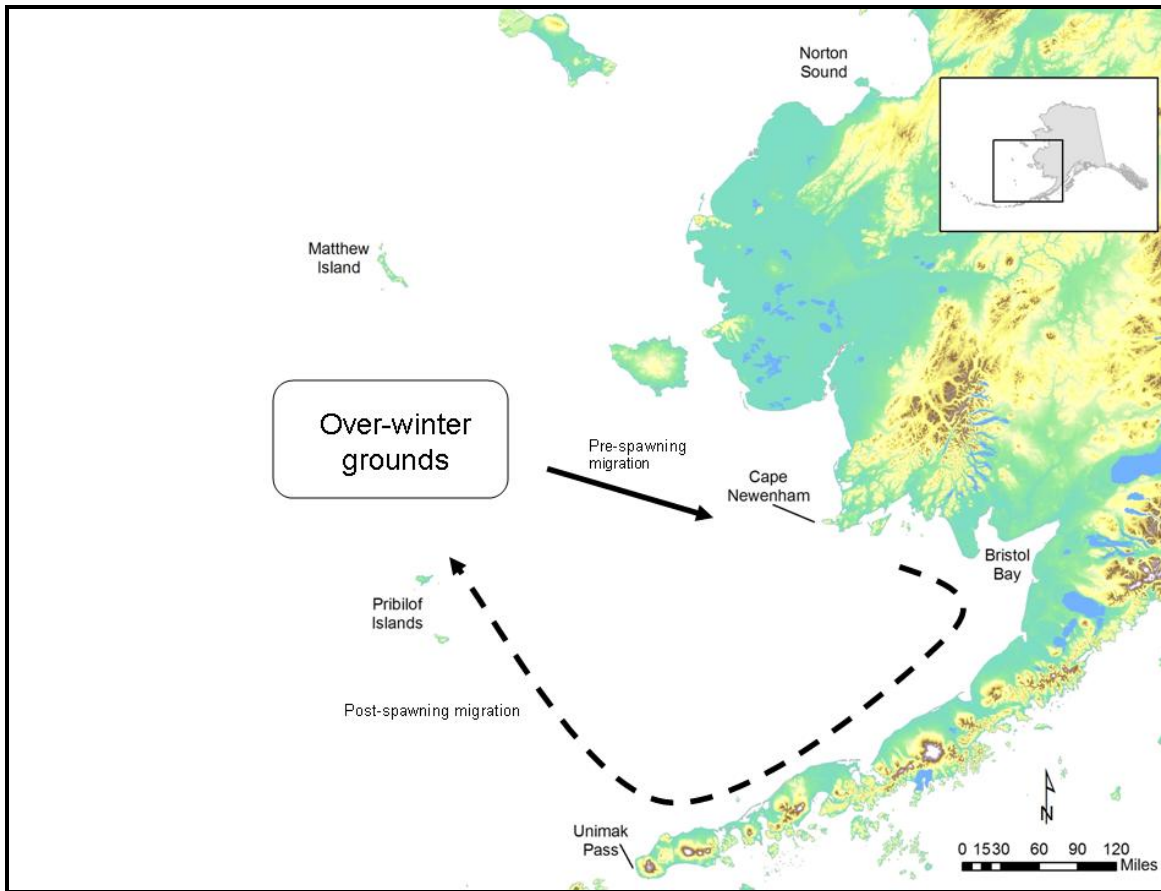
Figure 1.–Southeastern Bering Sea herring migration.
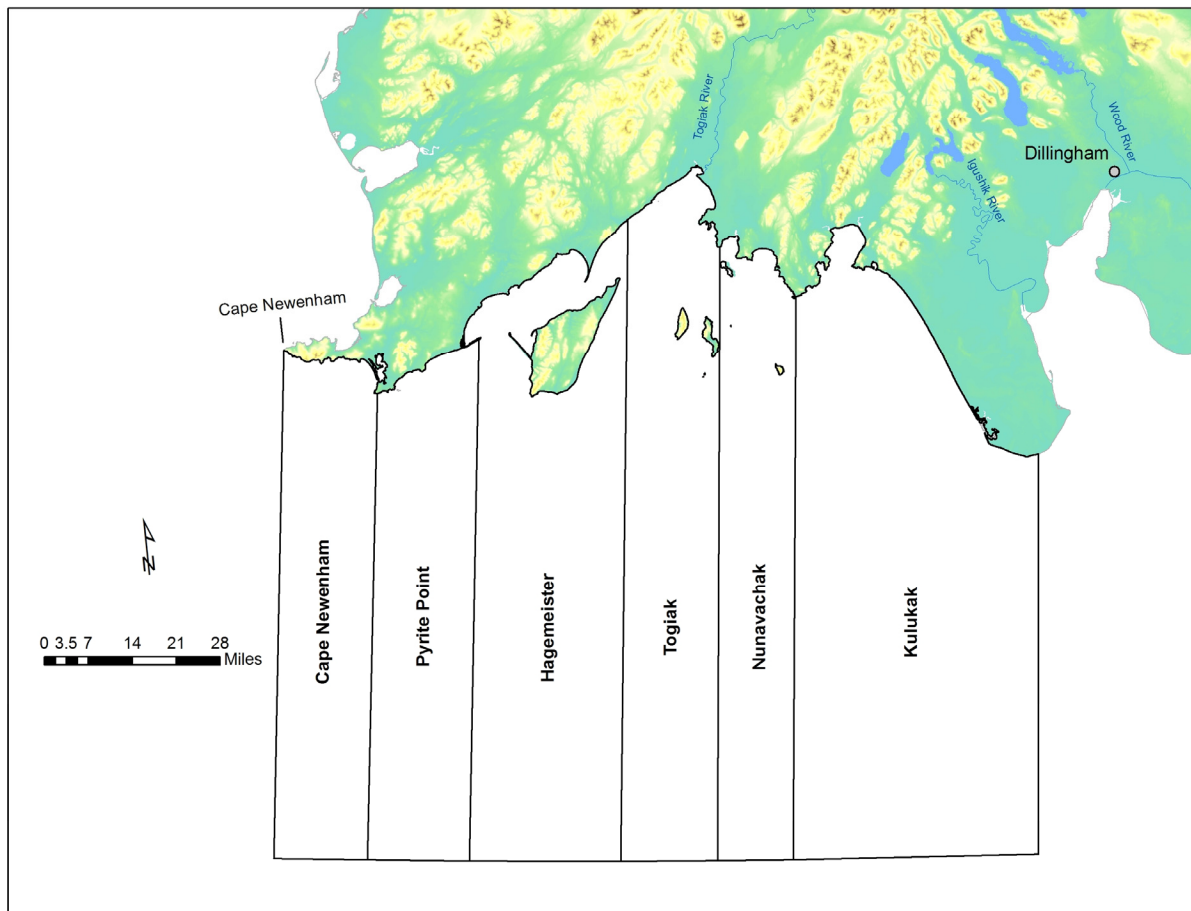
Figure 2.–Togiak commercial herring fishery management sections, Bristol Bay.
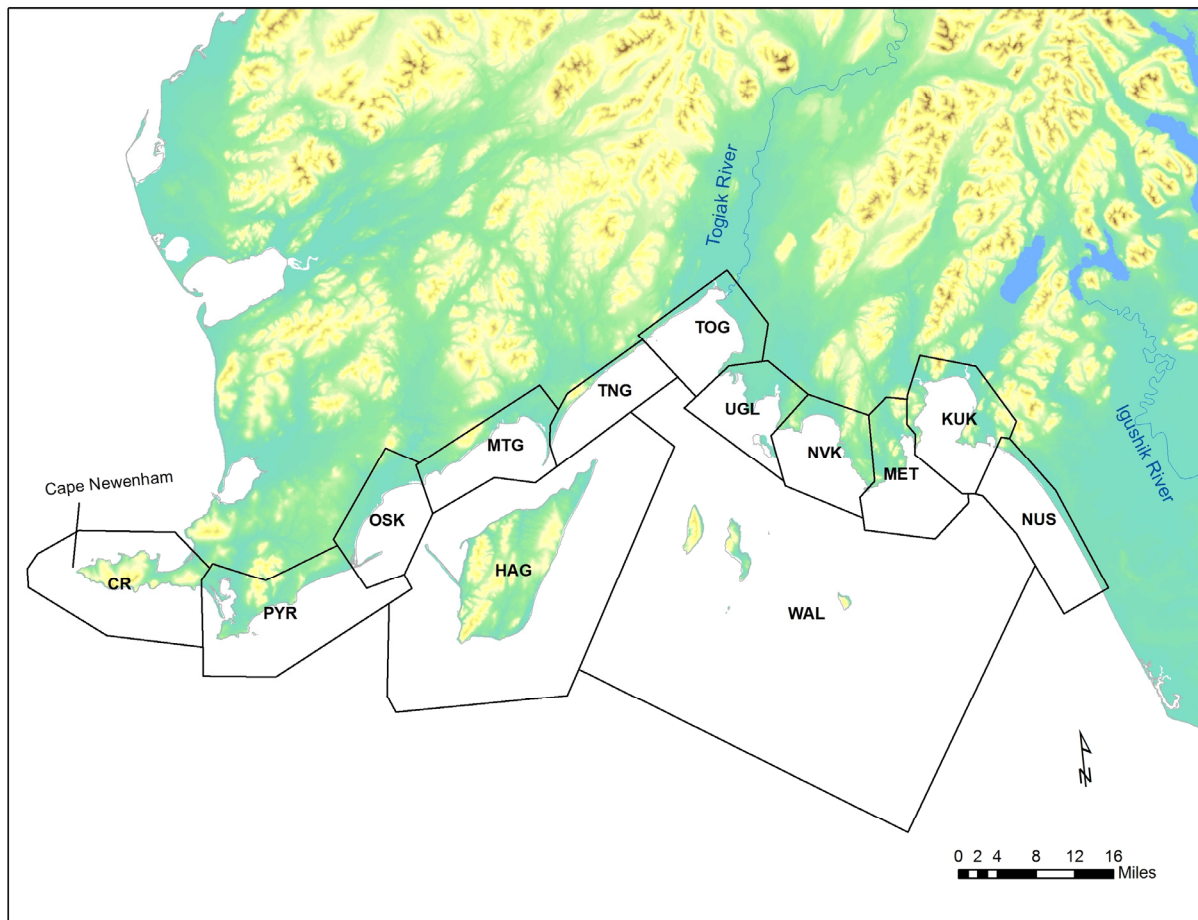
Figure 3.–Togiak herring aerial survey sections, Bristol Bay (NUS - Nushagak Peninsula; KUK - Kulukak; MET - Metervik; NVK - Nunavachak; UGL - Ungalikthluk/Togiak; TOG - Togiak; TNG - Tongue Pt; MTG - Matogak; OSK - Osvisak; PYT - Pyrite Point; CPN - Cape Newenham; HAG - Hagemeister; WAL – Walrus Islands).
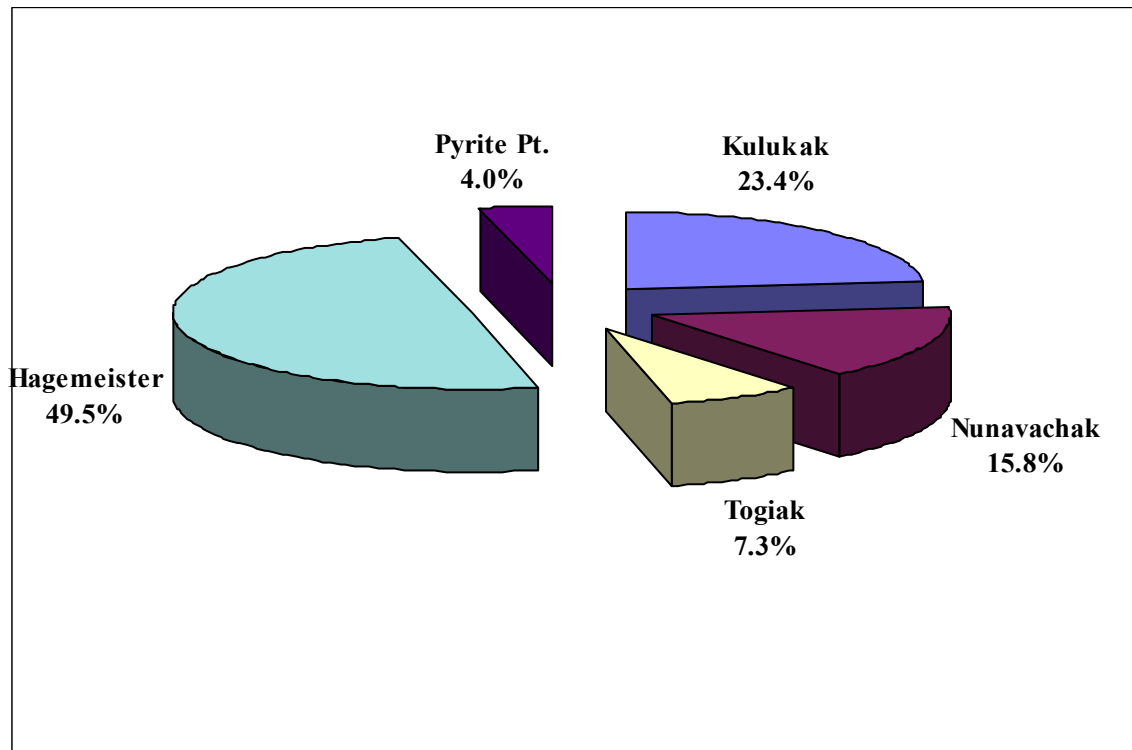
Figure 4.–Commercial harvest distribution by fishing section, Togiak District 2007.
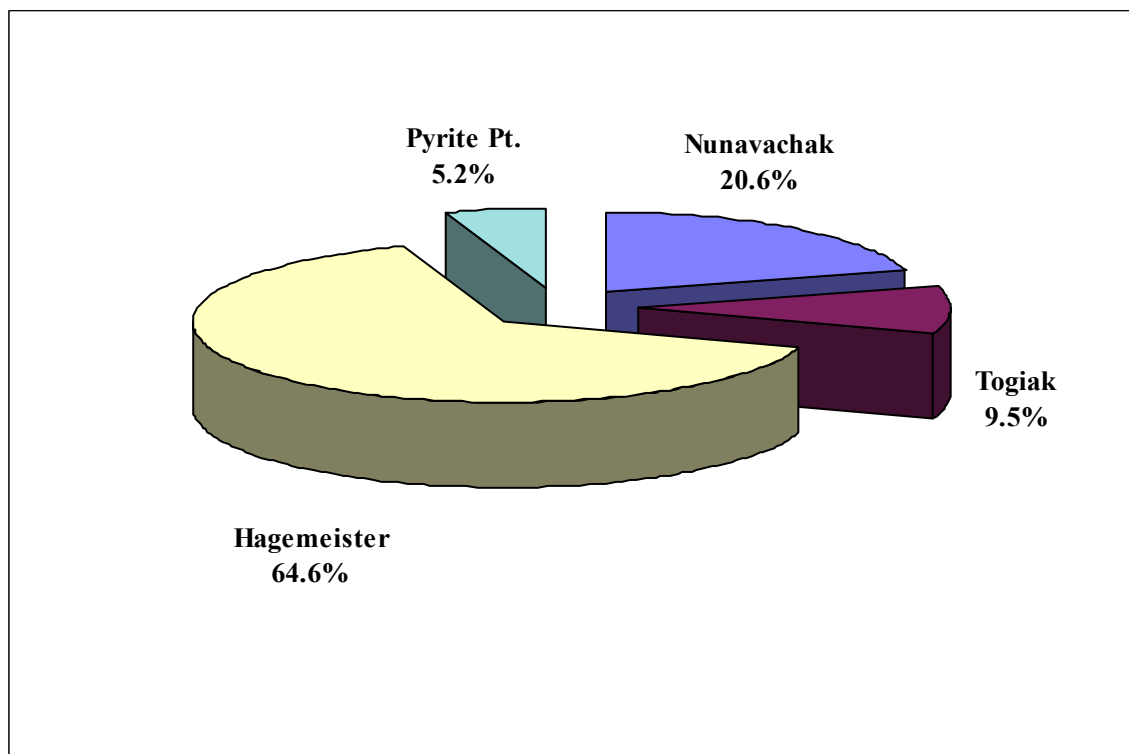
Figure 5.–Commercial purse seine harvest by fishing section, Togiak District 2007.
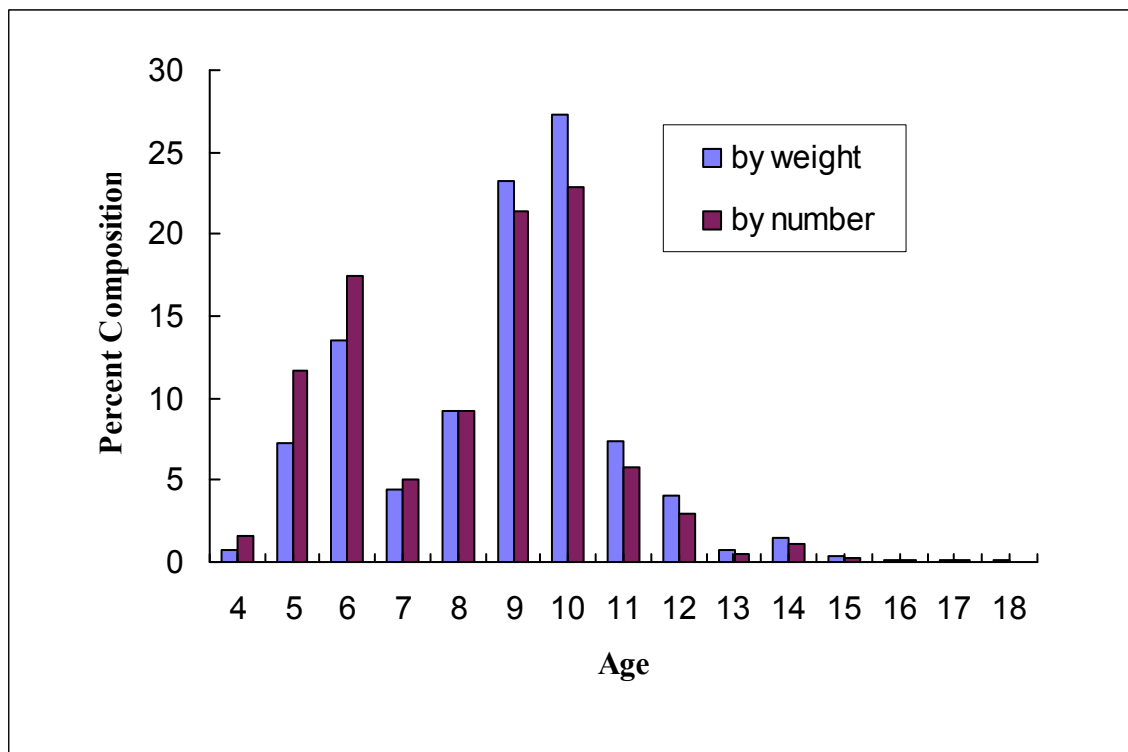
Figure 6.–Age composition of the total herring harvest, Togiak District, 2007.
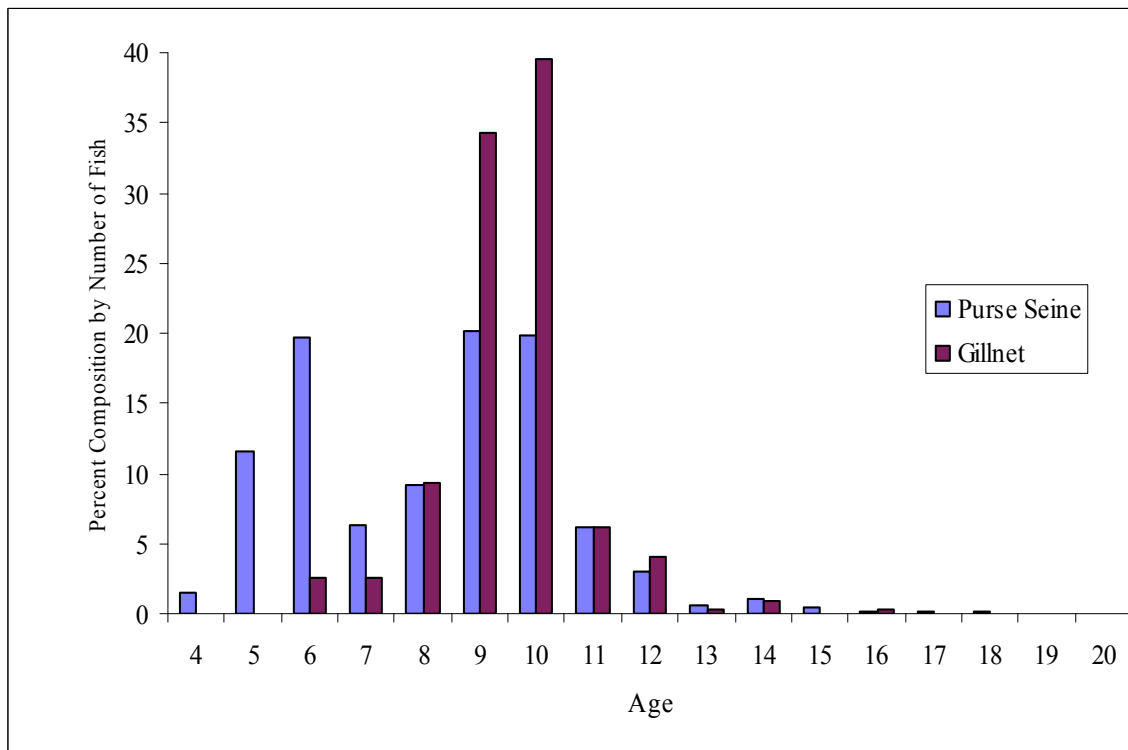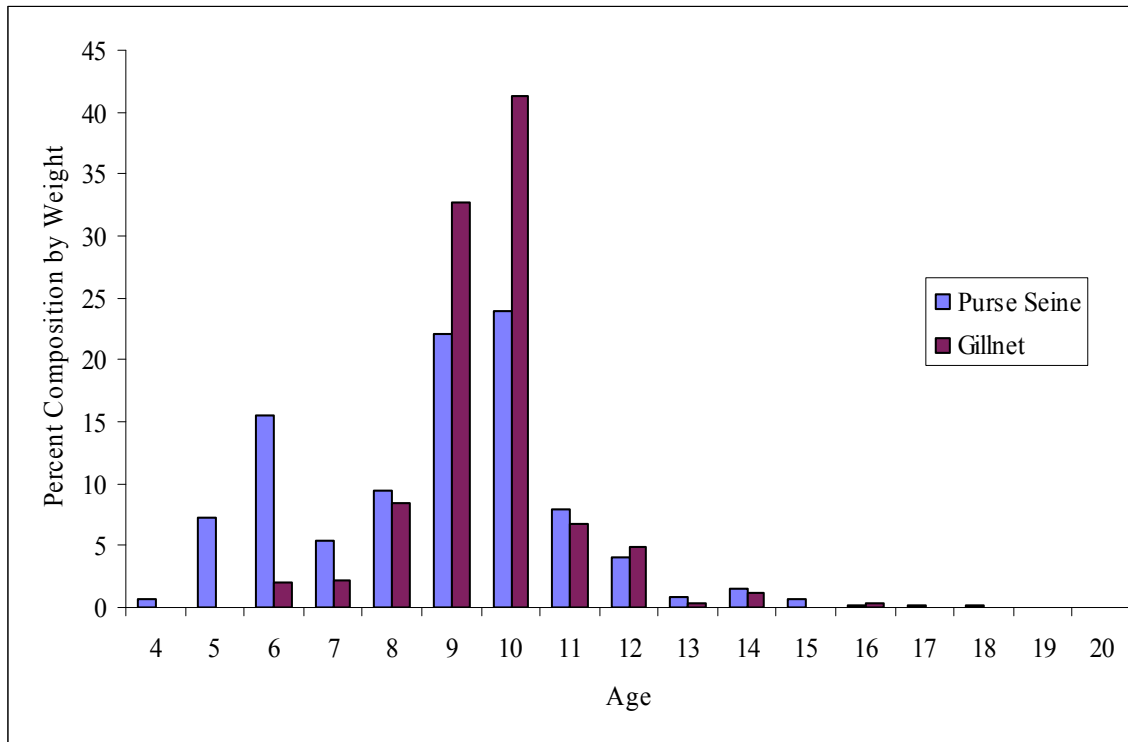
Figure 7.–Percent age composition of the commercial harvest by gear type for weight (top) and for numbers of fish (bottom), Togiak District, 2007.
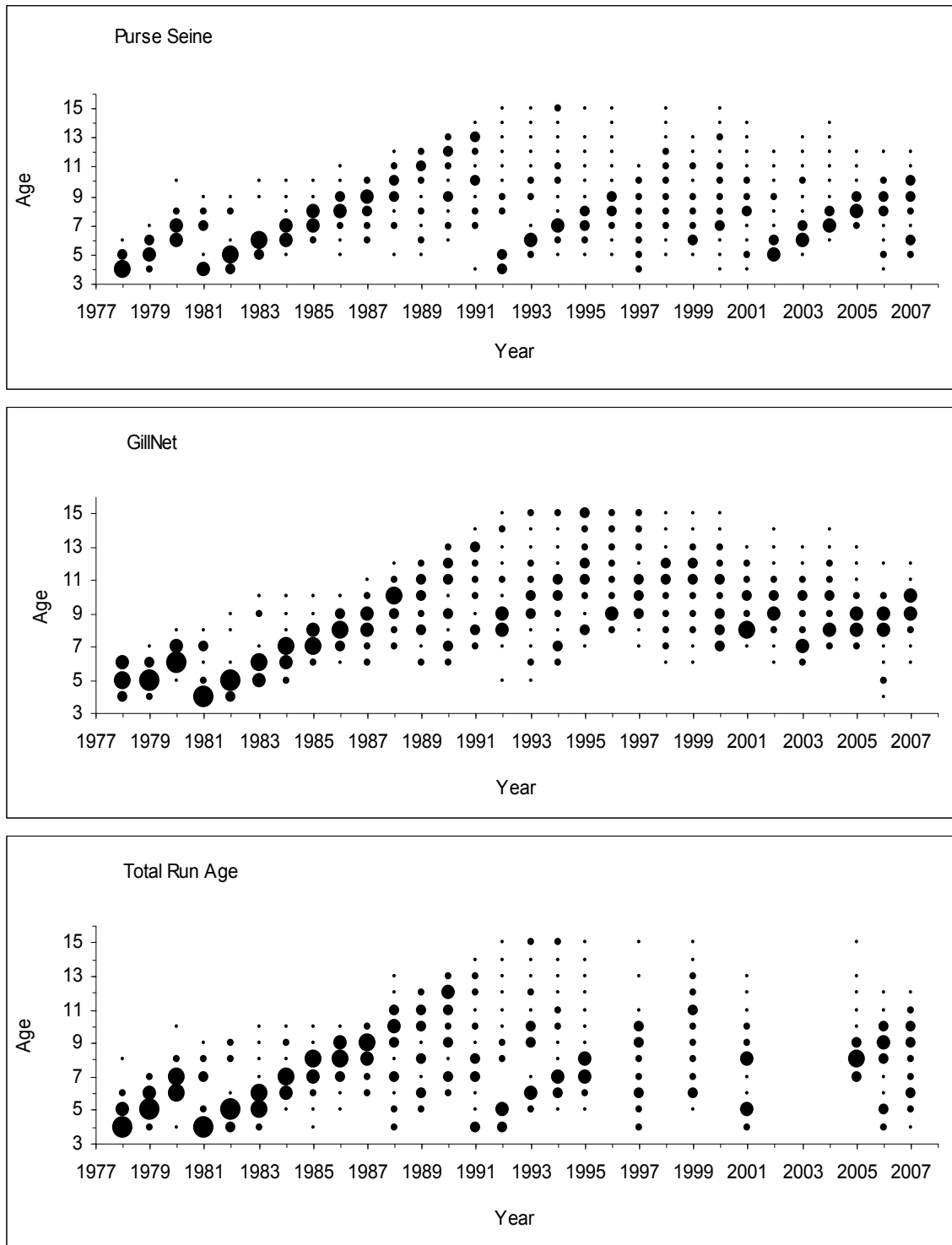
Figure 8.–Historic age composition (diameter of the circles represents percent age composition, determined by number of fish) of the purse seine harvest, gillnet harvest and total run, Togiak District, Bristol Bay, 1977–2007.

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APPENDIX A

Appendix A1.–Estimated age composition of the commercial purse seine harvest, by date and fishing section, Togiak District, 2007.

Sample Date(s):	10-12 May			Sample Date(s):	13-May			Sample Date(s):	14-May		
Section(s):	Nun, Pyp, Tog			Section(s):	Hag, Nun, Tog			Section(s):	Hag, Nun		
Harvest Biomass:	3,080.5			Harvest Biomass:	1,641.0			Harvest Biomass:	587.4		
Age	No. of Samples	Percent by No.	No. of fish (x1,000)	Age	No. of Samples	Percent by No.	No. of fish (x1,000)	Age	No. of Samples	Percent by No.	No. of fish (x1,000)
4	1	0.2	12	4	7	2.0	79	4	4	1.2	16
5	27	4.8	331	5	38	11.1	432	5	19	5.8	78
6	98	17.5	1,202	6	56	16.4	636	6	53	16.2	218
7	48	8.6	589	7	23	6.7	261	7	20	6.1	82
8	54	9.7	663	8	37	10.8	420	8	26	7.9	107
9	126	22.5	1,546	9	87	25.4	988	9	74	22.6	304
10	135	24.2	1,656	10	53	15.5	602	10	84	25.6	345
11	43	7.7	528	11	13	3.8	148	11	28	8.5	115
12	13	2.3	160	12	19	5.6	216	12	10	3.0	41
13	3	0.5	37	13	5	1.5	57	13	1	0.3	4
14	6	1.1	74	14	2	0.6	23	14	2	0.6	8
15	2	0.4	25	15	2	0.6	23	15	4	1.2	16
16	2	0.4	25	16	0	0.0	0	16	1	0.3	4
17	1	0.2	12	17	0	0.0	0	17	0	0.0	0
18	0	0.0	0	18	0	0.0	0	18	1	0.3	4
19	0	0.0	0	19	0	0.0	0	19	0	0.0	0
20	0	0.0	0	20	0	0.0	0	20	1	0.3	4
Total	559	100.0	6,859	Total	342	100.0	3,884	Total	328	100.0	1,347
Age	Weight	Percent by Weight	Biomass (tons)	Age	Weight	Percent by Weight	Biomass (tons)	Age	Weight	Percent by Weight	Biomass (tons)
4	172	0.1	2	4	1,289	1.0	16	4	676	0.5	3
5	6,682	2.9	90	5	9,146	7.0	114	5	4,654	3.6	21
6	29,820	13.1	403	6	16,790	12.8	210	6	15,601	12.0	71
7	16,306	7.2	221	7	7,146	5.5	89	7	6,834	5.3	31
8	20,979	9.2	284	8	14,626	11.2	183	8	9,790	7.5	44
9	53,148	23.3	719	9	36,007	27.5	451	9	29,768	22.9	135
10	63,771	28.0	863	10	24,321	18.6	304	10	37,892	29.2	172
11	21,515	9.4	291	11	6,418	4.9	80	11	14,004	10.8	63
12	7,131	3.1	96	12	10,239	7.8	128	12	5,112	3.9	23
13	1,661	0.7	22	13	2,739	2.1	34	13	575	0.4	3
14	3,585	1.6	48	14	1,202	0.9	15	14	1,073	0.8	5
15	1,146	0.5	16	15	1,168	0.9	15	15	2,055	1.6	9
16	1,271	0.6	17	16	0	0.0	0	16	597	0.5	3
17	568	0.2	8	17	0	0.0	0	17	0	0.0	0
18	0	0.0	0	18	0	0.0	0	18	511	0.4	2
19	0	0.0	0	19	0	0.0	0	19	0	0.0	0
20	0	0.0	0	20	0	0.0	0	20	592	0.5	3
Total	227,755	100.0	3,081	Total	131,091	100.0	1,641	Total	129,734	100.0	587

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Appendix A1.–Page 2 of 2.

Sample Date(s):	15-16 May
Section(s):	Hag, Pyp
Harvest Biomass:	2,456.7

Age	No. of Samples	Percent by No.	No. of fish (x1,000)
4	5	1.5	94
5	55	16.5	1,031
6	87	26.1	1,631
7	17	5.1	319
8	30	9.0	562
9	60	18.0	1,125
10	48	14.4	900
11	14	4.2	262
12	10	3.0	187
13	1	0.3	19
14	4	1.2	75
15	1	0.3	19
16	0	0.0	0
17	0	0.0	0
18	1	0.3	19
19	0	0.0	0
20	0	0.0	0
Total	333	100.0	6,243

Age	Weight	Percent by Weight	Biomass (tons)
4	976	0.8	20
5	13,206	11.1	273
6	26,006	21.9	537
7	5,623	4.7	116
8	11,384	9.6	235
9	24,582	20.7	508
10	21,585	18.2	446
11	6,852	5.8	142
12	4,961	4.2	103
13	419	0.4	9
14	2,156	1.8	45
15	572	0.5	12
16	0	0.0	0
17	0	0.0	0
18	548	0.5	11
19	0	0.0	0
20	0	0.0	0
Total	118,870	100.0	2,457

Sample Date(s):	18-20 May
Section(s):	Hag, Pyp
Harvest Biomass:	5,354.3

Age	No. of Samples	Percent by No.	No. of fish (x1,000)
4	15	3.2	450
5	96	20.4	2,878
6	108	22.9	3,237
7	19	4.0	570
8	41	8.7	1,229
9	64	13.6	1,918
10	84	17.8	2,518
11	26	5.5	779
12	8	1.7	240
13	2	0.4	60
14	6	1.3	180
15	1	0.2	30
16	0	0.0	0
17	1	0.2	30
18	0	0.0	0
19	0	0.0	0
20	0	0.0	0
Total	471	100.0	14,119

Age	Weight	Percent by Weight	Biomass (tons)
4	2,637	1.6	87
5	22,218	13.7	734
6	30,664	18.9	1,013
7	6,188	3.8	204
8	15,250	9.4	504
9	26,026	16.1	860
10	37,157	22.9	1,228
11	12,354	7.6	408
12	4,318	2.7	143
13	1,096	0.7	36
14	3,129	1.9	103
15	499	0.3	16
16	0	0.0	0
17	508	0.3	17
18	0	0.0	0
19	0	0.0	0
20	0	0.0	0
Total	162,044	100.0	5,354

Sample Date(s):	10-20 May
Section(s):	
Harvest Biomass:	13,120.0

Age	No. of Samples	Percent by No.	No. of fish (x1,000)
4	32	1.6	652
5	235	11.6	4,750
6	402	19.8	6,925
7	127	6.2	1,821
8	188	9.2	2,981
9	411	20.2	5,881
10	404	19.9	6,021
11	124	6.1	1,832
12	60	3.0	844
13	12	0.6	176
14	20	1.0	359
15	10	0.5	112
16	3	0.1	29
17	2	0.1	42
18	2	0.1	23
19	0	0.0	0
20	1	0.0	4
Total	2,033	100.0	32,452

Age	Weight	Percent by Weight	Biomass (tons)
4	5,750	0.7	129
5	55,906	7.3	1,233
6	118,881	15.4	2,235
7	42,097	5.5	662
8	72,029	9.4	1,250
9	169,531	22.0	2,672
10	184,726	24.0	3,012
11	61,143	7.9	985
12	31,761	4.1	493
13	6,490	0.8	104
14	11,145	1.4	216
15	5,440	0.7	68
16	1,868	0.2	20
17	1,076	0.1	24
18	1,059	0.1	14
19	0	0.0	0
20	592	0.1	3
Total	769,494	100.0	13,120

Appendix A2.–Estimated age composition of the commercial gillnet harvest, by date and fishing section, Togiak District, 2007.

Sample Date(s):		10-25 May	
Section(s):		Kul	
Harvest Biomass:		4,012.0	
Age	No. of Samples	Percent by No.	No. of fish (x1,000)
4	0	0.0	0
5	0	0.0	0
6	9	2.6	218
7	9	2.6	218
8	32	9.3	775
9	118	34.3	2,859
10	136	39.5	3,295
11	21	6.1	509
12	14	4.1	339
13	1	0.3	24
14	3	0.9	73
15	0	0.0	0
16	1	0.3	24
17	0	0.0	0
18	0	0.0	0
Total	344	100.0	8,334
Age	Weight	Percent by Weight	Biomass (tons)
4	0	0.0	0
5	0	0.0	0
6	2,996	2.0	80
7	3,229	2.1	86
8	12,666	8.4	338
9	49,166	32.7	1,313
10	61,986	41.3	1,655
11	10,173	6.8	272
12	7,369	4.9	197
13	499	0.3	13
14	1,728	1.2	46
15	0	0.0	0
16	422	0.3	11
17	0	0.0	0
18	0	0.0	0
Total	150,234	100.0	4,012

APPENDIX B

Appendix B1.–Age, sex and size composition of Pacific herring caught by commercial purse seine, Hagemeister Section, 13 May to 20 May, 2007.

Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	4	1	2	0	3	1.6	0.9	199	15.9	3	243	2.1	3
	5	8	9	0	17	9.3	2.2	244	24.5	17	258	9.1	17
	6	10	16	0	26	14.2	2.6	310	33.1	26	276	7.2	26
	7	2	9	0	11	6.0	1.8	318	32.9	11	283	7.7	11
	8	11	8	0	19	10.4	2.3	388	32.6	19	298	6.0	19
13-May	9	26	23	0	49	26.8	3.3	413	39.1	49	304	5.4	49
	10	13	21	0	34	18.6	2.9	470	38.9	34	314	6.9	34
	11	4	3	0	7	3.8	1.4	502	68.6	7	322	7.0	7
	12	9	3	0	12	6.6	1.8	512	50.8	12	327	5.0	12
	13	2	1	0	3	1.6	0.9	541	13.4	3	327	2.6	3
	14												
	15	0	2	0	2	1.1	0.8	584	26.9	2	344	4.9	2
Sample Total		86	97	0	183	100.0		395	93.6	183	298	22.2	183
	4	1	1	0	2	1.5	1.1	159	16.3	2	233	1.4	2
	5	4	7	0	11	8.2	2.4	234	20.9	11	256	7.8	11
	6	14	11	0	25	18.7	3.4	297	32.7	25	274	8.2	25
	7	2	4	0	6	4.5	1.8	348	33.4	6	288	6.8	6
	8	9	5	0	14	10.4	2.6	377	35.4	14	294	5.8	14
	9	14	10	0	24	17.9	3.3	407	34.4	24	303	5.1	24
	10	15	19	0	34	25.4	3.8	463	46.3	34	315	7.5	34
14-May	11	5	1	0	6	4.5	1.8	497	21.5	6	323	3.8	6
	12	2	4	0	6	4.5	1.8	530	57.9	6	332	4.8	6
	13												
	14	1	0	0	1	0.7	0.7	510		1	324		1
	15	3	0	0	3	2.2	1.3	510	42.5	3	331	7.8	3
	16												
	17												
	18	0	1	0	1	0.7	0.7	511		1	336		1
	19												
	20	0	1	0	1	0.7	0.7	592		1	338		1
Sample Total		70	64	0	134	100.0		392	97.5	134	298	24.1	134
	4	2	2	0	4	1.4	0.7	202	39.8	4	245	13.4	4
	5	26	20	0	46	15.8	2.1	240	31.5	46	255	10.3	46
	6	34	41	0	75	25.8	2.6	294	32.5	75	273	7.7	75
	7	7	9	0	16	5.5	1.3	330	39.2	16	282	6.4	16
	8	16	12	0	28	9.6	1.7	378	36.2	28	294	6.6	28
	9	30	20	0	50	17.2	2.2	407	36.5	50	302	4.8	50
15-May	10	25	20	0	45	15.5	2.1	450	45.7	45	314	5.7	45
	11	3	8	0	11	3.8	1.1	488	56.4	11	321	4.5	11
	12	7	2	0	9	3.1	1.0	494	60.1	9	328	7.3	9
	13	1	0	0	1	0.3	0.3	419		1	321		1
	14	3	1	0	4	1.4	0.7	539	30.0	4	331	6.3	4
	15	0	1	0	1	0.3	0.3	572		1	331		1
	16												
	17												
	18	1	0	0	1	0.3	0.3	548		1	345		1
Sample Total		155	136	0	291	100.0		357	93.6	291	289	24.3	291

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Sample Dates	Age	Sex (number)				Percent of Total	SE	Weight			Length		
		Male	Female	Unk.	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	4	2	3	0	5	3.0	1.3	184	19.6	5	240	7.8	5
	5	11	13	0	24	14.2	2.7	252	34.0	24	261	9.2	24
	6	23	17	0	40	23.7	3.3	290	36.0	40	275	7.5	40
	7	2	2	0	4	2.4	1.2	351	24.0	4	291	3.9	4
	8	7	5	0	12	7.1	2.0	364	45.6	12	297	7.5	12
	9	13	9	0	22	13.0	2.6	399	41.3	22	305	5.0	22
18-May	10	21	22	0	43	25.4	3.4	433	43.1	43	314	6.0	43
	11	3	5	0	8	4.7	1.6	473	49.2	8	324	6.3	8
	12	2	3	0	5	3.0	1.3	531	57.0	5	332	7.1	5
	13	1	1	0	2	1.2	0.8	548	38.9	2	331	4.9	2
	14	3	0	0	3	1.8	1.0	493	29.5	3	332	4.2	3
	15												
	16												
	17	0	1	0	1	0.6	0.6	508		1	337		1
Sample Total		88	81	0	169	100.0		362	95.8	169	294	25.2	169
	5	3	7	0	10	13.2	3.9	220	30.0	10	254	10.7	10
	6	5	7	0	12	15.8	4.2	282	34.9	12	273	7.5	12
	7	1	1	0	2	2.6	1.8	332	18.4	2	288	2.8	2
	8	2	3	0	5	6.6	2.9	384	48.0	5	297	6.2	5
	9	10	8	0	18	23.7	4.9	409	35.2	18	303	3.7	18
19-May	10	4	12	0	16	21.1	4.7	467	62.4	16	315	6.2	16
	11	6	3	0	9	11.8	3.7	485	28.7	9	320	5.3	9
	12	1	0	0	1	1.3	1.3	431		1	321		1
	13												
	14	1	2	0	3	3.9	2.2	550	88.2	3	333	9.6	3
Sample Total		33	43	0	76	100.0		387	105.1	76	297	24.2	76
	4	0	3	0	3	3.3	1.9	150	15.0	3	224	2.1	3
	5	7	3	0	10	10.9	3.3	227	39.6	10	254	9.8	10
	6	11	10	0	21	22.8	4.4	275	38.3	21	270	8.2	21
	7	2	2	0	4	4.3	2.1	337	26.8	4	289	4.0	4
	8	8	6	0	14	15.2	3.8	368	38.9	14	295	5.0	14
	9	6	11	0	17	18.5	4.1	423	44.9	17	304	6.1	17
20-May	10	11	5	0	16	17.4	4.0	443	36.6	16	312	4.5	16
	11	2	2	0	4	4.3	2.1	470	26.7	4	319	6.0	4
	12	0	2	0	2	2.2	1.5	616	22.6	2	337	0.0	2
	13												
	14												
	15	1	0	0	1	1.1	1.1	499		1	338		1
Sample Total		48	44	0	92	100.0		357	102.8	92	289	25.6	92

Appendix B1.–Page 3 of 3.

Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	4	6	11	0	17	1.8	0.4	182	29.7	17	238	10.2	17
	5	59	59	0	118	12.5	1.1	240	31.6	118	257	9.8	118
	6	97	102	0	199	21.1	1.3	293	34.9	199	274	7.7	199
	7	16	27	0	43	4.6	0.7	332	34.2	43	285	6.9	43
	8	53	39	0	92	9.7	1.0	377	37.5	92	296	6.3	92
	9	99	81	0	180	19.0	1.3	409	38.2	180	303	5.1	180
	10	89	99	0	188	19.9	1.3	453	46.5	188	314	6.3	188
13 - 20 May	11	23	22	0	45	4.8	0.7	487	46.0	45	322	5.4	45
	12	21	14	0	35	3.7	0.6	517	59.9	35	329	6.3	35
	13	4	2	0	6	0.6	0.3	523	54.5	6	327	4.4	6
	14	8	3	0	11	1.2	0.4	527	51.0	11	331	6.4	11
	15	4	3	0	7	0.7	0.3	539	47.5	7	335	7.8	7
	16												
	17	0	1	0	1	0.1	0.1	508		1	337		1
	18	1	1	0	2	0.2	0.1	530	26.2	2	341	6.4	2
	19												
	20	0	1	0	1	0.1	0.1	592		1	338		1
All Samples Combined		480	465	0	945	100.0		373	97.6	945	293	24.4	945
Sex Composition		50.8	49.2										
Unaged		64	61	0	125	13.2		403	87.6	125	301	20.8	125
Sex Composition		51.2	48.8										

Appendix B2.–Age, sex and size composition of Pacific herring caught by commercial purse seine, Nunavachack Section, 12 May to 14 May, 2007.

Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	5	5	6	0	11	4.1	1.2	254	30.6	11	261	6.5	11
	6	28	32	0	60	22.2	2.5	307	29.6	60	276	6.7	60
	7	10	16	0	26	9.6	1.8	342	33.7	26	286	7.5	26
	8	14	13	0	27	10.0	1.8	391	35.9	27	296	6.0	27
	9	28	32	0	60	22.2	2.5	415	35.2	60	302	4.2	60
12-May	10	26	36	0	62	23.0	2.6	474	47.8	62	316	6.4	62
	11	10	8	0	18	6.7	1.5	480	32.4	18	319	6.5	18
	12	1	0	0	1	0.4	0.4	471		1	322		1
	13	0	1	0	1	0.4	0.4	561		1	331		1
	14	1	2	0	3	1.1	0.6	604	25.0	3	339	10.3	3
	15	1	0	0	1	0.4	0.4	525		1	332		1
	16	0	1	0	1	0.4	0.4	601		1	362		1
Sample Total		124	147	0	271	100.0		397	83.2	271	298	19.1	271
	4	1	1	0	2	1.0	0.7	179	2.8	2	237	4.2	2
	5	7	1	0	8	4.1	1.4	260	34.8	8	261	11.4	8
	6	12	16	0	28	14.4	2.5	292	32.1	28	274	9.3	28
	7	2	12	0	14	7.2	1.9	339	39.2	14	285	10.2	14
	8	6	6	0	12	6.2	1.7	376	62.5	12	295	6.7	12
	9	33	17	0	50	25.8	3.1	400	41.1	50	304	6.1	50
14-May	10	23	27	0	50	25.8	3.1	443	51.4	50	313	8.0	50
	11	8	14	0	22	11.3	2.3	501	63.4	22	322	9.7	22
	12	3	1	0	4	2.1	1.0	483	37.5	4	329	3.6	4
	13	0	1	0	1	0.5	0.5	575		1	346		1
	14	0	1	0	1	0.5	0.5	563		1	323		1
	15	0	1	0	1	0.5	0.5	525		1	335		1
	16	0	1	0	1	0.5	0.5	597		1	341		1
Sample Total		95	99	0	194	100.0		398	88.0	194	301	20.7	194
	4	1	1	0	2	0.4	0.3	179	2.8	2	237	4.2	2
	5	12	7	0	19	4.1	0.9	257	31.6	19	261	8.6	19
	6	40	48	0	88	18.9	1.8	302	31.1	88	276	7.7	88
	7	12	28	0	40	8.6	1.3	341	35.3	40	286	8.5	40
	8	20	19	0	39	8.4	1.3	385	45.3	39	296	6.2	39
	9	61	49	0	110	23.7	2.0	408	38.6	110	303	5.2	110
12-14 May	10	49	63	0	112	24.1	2.0	460	51.6	112	315	7.3	112
	11	18	22	0	40	8.6	1.3	491	52.4	40	320	8.5	40
	12	4	1	0	5	1.1	0.5	480	32.9	5	328	4.5	5
	13	0	2	0	2	0.4	0.3	568	9.9	2	339	10.6	2
	14	1	3	0	4	0.9	0.4	594	28.8	4	335	11.7	4
	15	1	1	0	2	0.4	0.3	525	0.0	2	334	2.1	2
	16	0	2	0	2	0.4	0.3	599	2.8	2	352	14.8	2
All Samples Combined		219	246	0	465	100.0		397	85.1	465	299	19.8	465
Sex Composition		47.1	52.9										
Unaged		32	33	0	65	14.0		411	98.0	65	302	21.9	65
Sex Composition		49.2	50.8										

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Appendix B3.−Age, sex and size composition of Pacific herring caught by commercial purse seine, Pyrite Point Section, 16 May to 19 May, 2007.

| Sample Dates | Age | Sex (number) | | | | Percent of Total | SE | Weight | | | Length | | |
		Male	Female	Unk.	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	4	0	1	0	1	2.4	2.4	168		1	231		1
	5	4	5	0	9	21.4	6.4	240	25.3	9	253	5.7	9
	6	6	6	0	12	28.6	7.1	326	21.3	12	279	6.5	12
16-May	7	0	1	0	1	2.4	2.4	333		1	280		1
	8	0	2	0	2	4.8	3.3	396	53.0	2	298	0.0	2
	9	5	5	0	10	23.8	6.7	426	35.2	10	305	5.7	10
	10	1	2	0	3	7.1	4.0	445	28.5	3	313	0.6	3
	11	1	2	0	3	7.1	4.0	493	23.5	3	321	5.0	3
	12	0	1	0	1	2.4	2.4	517		1	320		1
Sample Total		17	25	0	42	100.0		356	92.5	42	286	25.0	42
	4	5	2	0	7	5.2	1.9	181	17.7	7	242	6.7	7
	5	31	21	0	52	38.8	4.2	225	27.6	52	255	9.2	52
	6	21	14	0	35	26.1	3.8	283	28.4	35	275	9.0	35
19-May	7	4	5	0	9	6.7	2.2	308	27.8	9	280	5.4	9
	8	8	2	0	10	7.5	2.3	381	25.5	10	297	4.9	10
	9	5	2	0	7	5.2	1.9	385	22.6	7	301	5.8	7
	10	6	3	0	9	6.7	2.2	442	34.3	9	313	6.5	9
	11	3	2	0	5	3.7	1.6	465	54.5	5	322	5.3	5
Sample Total		83	51	0	134	100.0		287	83.1	134	273	22.9	134
	4	5	3	0	8	4.5	1.6	180	17.0	8	240	7.2	8
	5	35	26	0	61	34.7	3.6	227	27.6	61	255	8.8	61
	6	27	20	0	47	26.7	3.3	294	32.5	47	276	8.6	47
16-19 May	7	4	6	0	10	5.7	1.8	310	27.4	10	280	5.1	10
	8	8	4	0	12	6.8	1.9	384	28.6	12	297	4.4	12
	9	10	7	0	17	9.7	2.2	409	36.1	17	303	6.0	17
	10	7	5	0	12	6.8	1.9	443	31.7	12	313	5.6	12
	11	4	4	0	8	4.5	1.6	475	45.4	8	322	4.9	8
	12	0	1	0	1	0.6	0.6	517		1	320		1
All Samples Combined		100	76	0	176	100.0		303	90.1	176	276	24.0	176
Sex Composition		56.8	43.2										
Unaged		8	11	0	19	10.8		328	96.0	19	282	26.2	19
Sex Composition		42.1	57.9										

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Appendix B4.–Age, sex and size composition of Pacific herring caught by commercial purse seine, Togiak Section, 11 May to 13 May, 2007.

Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	4	1	0	0	1	0.3	0.3	172		1	232		1
	5	9	7	0	16	5.6	1.4	243	29.0	16	258	6.2	16
	6	13	25	0	38	13.2	2.0	300	26.7	38	273	7.3	38
	7	9	13	0	22	7.6	1.6	337	42.4	22	283	7.8	22
	8	18	9	0	27	9.4	1.7	387	30.5	27	294	5.2	27
	9	37	29	0	66	22.9	2.5	428	33.1	66	303	5.4	66
11-May	10	32	41	0	73	25.3	2.6	471	36.4	73	313	5.6	73
	11	13	12	0	25	8.7	1.7	515	47.6	25	320	7.7	25
	12	4	8	0	12	4.2	1.2	555	37.7	12	330	6.4	12
	13	1	1	0	2	0.7	0.5	550	12.7	2	331	3.5	2
	14	2	1	0	3	1.0	0.6	591	21.1	3	339	6.2	3
	15	0	1	0	1	0.3	0.3	621		1	345		1
	16	0	1	0	1	0.3	0.3	670		1	348		1
	17	1	0	0	1	0.3	0.3	568		1	338		1
Sample Total		140	148	0	288	100.0		418	93.7	288	300	20.9	288
	4	0	4	0	4	2.5	1.2	173	6.5	4	237	1.0	4
	5	10	11	0	21	13.2	2.7	238	39.3	21	259	11.6	21
	6	10	20	0	30	18.9	3.1	291	35.2	30	273	9.3	30
	7	5	7	0	12	7.5	2.1	304	22.0	12	279	4.4	12
	8	9	9	0	18	11.3	2.5	403	32.4	18	299	5.6	18
	9	21	17	0	38	23.9	3.4	415	40.1	38	304	5.8	38
13-May	10	10	9	0	19	11.9	2.6	439	46.9	19	313	6.9	19
	11	3	3	0	6	3.8	1.5	484	18.9	6	321	4.2	6
	12	1	6	0	7	4.4	1.6	585	78.4	7	339	10.5	7
	13	1	1	0	2	1.3	0.9	558	38.2	2	331	5.7	2
	14	0	2	0	2	1.3	0.9	601	90.5	2	341	14.8	2
Sample Total		70	89	0	159	100.0		370	105.7	159	292	25.1	159
	4	1	4	0	5	1.1	0.5	172	5.6	5	236	2.3	5
	5	19	18	0	37	8.3	1.3	240	34.9	37	258	9.6	37
	6	23	45	0	68	15.2	1.7	296	30.8	68	273	8.2	68
	7	14	20	0	34	7.6	1.3	326	39.5	34	281	6.9	34
	8	27	18	0	45	10.1	1.4	394	31.9	45	296	5.9	45
11-13 May	9	58	46	0	104	23.3	2.0	424	36.2	104	303	5.5	104
	10	42	50	0	92	20.6	1.9	465	40.8	92	313	5.8	92
	11	16	15	0	31	6.9	1.2	509	45.1	31	320	7.1	31
	12	5	14	0	19	4.3	1.0	566	56.1	19	333	9.1	19
	13	2	2	0	4	0.9	0.4	554	23.7	4	331	3.9	4
	14	2	3	0	5	1.1	0.5	595	47.9	5	340	8.7	5
	15	0	1	0	1	0.2	0.2	621		1	345		1
	16	0	1	0	1	0.2	0.2	670		1	348		1
	17	1	0	0	1	0.2	0.2	568		1	338		1
All Samples Combined		210	237	0	447	100.0		401	100.7	447	297	22.8	447
Sex Composition		47.0	53.0										
Unaged		26	37	0	63	14.1		420	99.6	63	302	21.5	63
Sex Composition		41.3	58.7										

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Appendix B5.–Age, sex and size composition of Pacific herring caught by commercial purse seine, Hagemeister, Nunavachak, Pyrite Point, and Togiak Section, 11 May to 20 May, 2007.

Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	4	1	0	0	1	0.3	0.3	172		1	232		1
	5	9	7	0	16	5.6	1.4	243	29.0	16	258	6.2	16
	6	13	25	0	38	13.2	2.0	300	26.7	38	273	7.3	38
	7	9	13	0	22	7.6	1.6	337	42.4	22	283	7.8	22
	8	18	9	0	27	9.4	1.7	387	30.5	27	294	5.2	27
	9	37	29	0	66	22.9	2.5	428	33.1	66	303	5.4	66
	10	32	41	0	73	25.3	2.6	471	36.4	73	313	5.6	73
11-May	11	13	12	0	25	8.7	1.7	515	47.6	25	320	7.7	25
	12	4	8	0	12	4.2	1.2	555	37.7	12	330	6.4	12
	13	1	1	0	2	0.7	0.5	550	12.7	2	331	3.5	2
	14	2	1	0	3	1.0	0.6	591	21.1	3	339	6.2	3
	15	0	1	0	1	0.3	0.3	621		1	345		1
	16	0	1	0	1	0.3	0.3	670		1	348		1
	17	1	0	0	1	0.3	0.3	568		1	338		1
Sample Total		140	148	0	288	100.0		418	93.7	288	300	20.9	288
	5	5	6	0	11	4.1	1.2	254	30.6	11	261	6.5	11
	6	28	32	0	60	22.1	2.5	307	29.6	60	276	6.7	60
	7	10	16	0	26	9.6	1.8	342	33.7	26	286	7.5	26
	8	14	13	0	27	10.0	1.8	390	35.9	27	296	6.0	27
	9	28	32	0	60	22.1	2.5	415	35.2	60	302	4.2	60
	10	26	36	0	62	22.9	2.6	474	47.8	62	316	6.4	62
12-May	11	10	8	0	18	6.6	1.5	480	32.4	18	319	6.5	18
	12	1	0	0	1	0.4	0.4	471		1	322		1
	13	0	1	0	1	0.4	0.4	561		1	331		1
	14	1	2	0	3	1.1	0.6	604	25.0	3	339	10.3	3
	15	1	0	0	1	0.4	0.4	525		1	332		1
	16	0	1	0	1	0.4	0.4	601		1	362		1
Sample Total		124	147	0	271	100.0		397	83.2	271	298	19.1	271
	4	1	6	0	7	2.0	0.8	184	17.5	7	239	3.5	7
	5	18	20	0	38	11.1	1.7	241	33.2	38	259	10.4	38
	6	20	36	0	56	16.4	2.0	300	35.2	56	274	8.4	56
	7	7	16	0	23	6.7	1.4	311	27.9	23	281	6.4	23
	8	20	17	0	37	10.8	1.7	395	33.0	37	298	5.8	37
	9	47	40	0	87	25.4	2.4	414	39.3	87	304	5.5	87
	10	23	30	0	53	15.5	2.0	459	44.2	53	314	6.8	53
13-May	11	7	6	0	13	3.8	1.0	494	50.9	13	322	5.7	13
	12	10	9	0	19	5.6	1.2	539	70.3	19	331	9.3	19
	13	3	2	0	5	1.5	0.7	548	23.3	5	329	4.0	5
	14	0	2	0	2	0.6	0.4	601	90.5	2	341	14.8	2
	15	0	2	0	2	0.6	0.4	584	26.9	2	344	4.9	2
Sample Total		156	186	0	342	100.0		383	100.1	342	295	23.7	342

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Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	4	2	2	0	4	1.2	0.6	169	15.2	4	235	3.5	4
	5	11	8	0	19	5.8	1.3	245	29.7	19	258	9.6	19
	6	26	27	0	53	16.2	2.0	294	32.2	53	274	8.7	53
	7	4	16	0	20	6.1	1.3	342	36.9	20	286	9.3	20
	8	15	11	0	26	7.9	1.5	376	48.7	26	294	6.1	26
	9	47	27	0	74	22.6	2.3	402	39.0	74	304	5.8	74
	10	38	46	0	84	25.6	2.4	451	50.1	84	314	7.9	84
14-May	11	13	15	0	28	8.5	1.5	500	56.7	28	322	8.7	28
	12	5	5	0	10	3.0	0.9	511	54.2	10	331	4.4	10
	13	0	1	0	1	0.3	0.3	575		1	346		1
	14	1	1	0	2	0.6	0.4	537	37.5	2	324	0.7	2
	15	3	1	0	4	1.2	0.6	514	35.5	4	332	6.7	4
	16	0	1	0	1	0.3	0.3	597		1	341		1
	17												
	18	0	1	0	1	0.3	0.3	511		1	336		1
	19												
	20	0	1	0	1	0.3	0.3	592		1	338		1
Sample Total		165	163	0	328	100.0		395	91.9	328	300	22.2	328
	4	1	1	0	2	1.1	0.8	168	7.8	2	234	0.7	2
	5	12	10	0	22	12.0	2.4	249	22.0	22	259	7.0	22
	6	17	27	0	44	23.9	3.2	295	33.4	44	272	6.7	44
	7	4	6	0	10	5.4	1.7	343	29.3	10	283	5.6	10
	8	12	10	0	22	12.0	2.4	380	38.6	22	294	6.8	22
	9	22	14	0	36	19.6	2.9	407	36.4	36	302	5.0	36
	10	17	11	0	28	15.2	2.7	450	42.0	28	314	5.0	28
15-May	11	1	7	0	8	4.3	1.5	504	41.4	8	321	5.0	8
	12	5	0	0	5	2.7	1.2	492	53.5	5	328	7.2	5
	13	1	0	0	1	0.5	0.5	419		1	321		1
	14	3	1	0	4	2.2	1.1	539	30.0	4	331	6.3	4
	15	0	1	0	1	0.5	0.5	572		1	331		1
	16												
	17												
	18	1	0	0	1	0.5	0.5	548		1	345		1
Sample Total		96	88	0	184	100.0		370	91.1	184	291	23.0	184
	4	1	2	0	3	2.0	1.2	213	39.3	3	248	15.0	3
	5	18	15	0	33	22.1	3.4	234	33.8	33	252	10.4	33
	6	23	20	0	43	28.9	3.7	303	32.4	43	276	8.3	43
	7	3	4	0	7	4.7	1.7	313	44.0	7	280	7.1	7
	8	4	4	0	8	5.4	1.9	378	32.9	8	296	5.4	8
	9	13	11	0	24	16.1	3.0	414	37.6	24	304	4.8	24
16-May	10	9	11	0	20	13.4	2.8	450	49.2	20	315	6.2	20
	11	3	3	0	6	4.0	1.6	470	58.2	6	321	3.9	6
	12	2	3	0	5	3.4	1.5	500	66.7	5	327	8.3	5
Sample Total		76	73	0	149	100.0		341	94.1	149	285	25.6	149

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Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	8	7	5	0	12	7.1	2.0	364	45.6	12	297	7.5	12
	9	13	9	0	22	13.0	2.6	399	41.3	22	305	5.0	22
	10	21	22	0	43	25.4	3.4	433	43.1	43	314	6.0	43
	11	3	5	0	8	4.7	1.6	473	49.2	8	324	6.3	8
18-May	12	2	3	0	5	3.0	1.3	531	57.0	5	332	7.1	5
	13	1	1	0	2	1.2	0.8	548	38.9	2	331	4.9	2
	14	3	0	0	3	1.8	1.0	493	29.5	3	332	4.2	3
	15												
	16												
	17	0	1	0	1	0.6	0.6	508		1	337		1
Sample Total		88	81	0	169	100.0		362	95.8	169	294	25.2	169
	4	5	2	0	7	3.3	1.3	181	17.7	7	242	6.7	7
	5	34	28	0	62	29.5	3.4	224	27.8	62	255	9.4	62
	6	26	21	0	47	22.4	3.1	283	29.8	47	274	8.6	47
	7	5	6	0	11	5.2	1.6	312	27.3	11	282	5.8	11
	8	10	5	0	15	7.1	1.9	382	32.8	15	297	5.1	15
19-May	9	15	10	0	25	11.9	2.4	402	33.5	25	302	4.3	25
	10	10	15	0	25	11.9	2.4	458	54.6	25	315	6.3	25
	11	9	5	0	14	6.7	1.8	478	39.0	14	321	5.2	14
	12	1	0	0	1	0.5	0.5	431		1	321		1
	13												
	14	1	2	0	3	1.4	0.9	550	88.2	3	333	9.6	3
Sample Total		116	94	0	210	100.0		323	103.4	210	282	26.0	210
	4	0	3	0	3	3.3	1.3	150	15.0	3	224	2.1	3
	5	7	3	0	10	10.9	2.3	227	39.6	10	254	9.8	10
	6	11	10	0	21	22.8	3.1	275	38.3	21	270	8.2	21
	7	2	2	0	4	4.3	1.5	337	26.8	4	289	4.0	4
	8	8	6	0	14	15.2	2.7	368	38.9	14	295	5.0	14
20-May	9	6	11	0	17	18.5	2.9	423	44.9	17	304	6.1	17
	10	11	5	0	16	17.4	2.8	443	36.6	16	312	4.5	16
	11	2	2	0	4	4.3	1.5	470	26.7	4	319	6.0	4
	12	0	2	0	2	2.2	1.1	616	22.6	2	337	0.0	2
	13												
	14												
	15	1	0	0	1	1.1	0.8	499		1	338		1
Sample Total		48	44	0	92	100.0		357	102.8	92	289	25.6	92

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| Sample Dates | Age | Sex (number) | | | | Percent of Total | SE | Weight | | | Length | | |
		Male	Female	Unk.	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	4	13	19	0	32	1.6	0.3	180	23.1	32	238	8.3	32
	5	125	110	0	235	11.6	0.7	238	31.9	235	257	9.5	235
	6	187	215	0	402	19.8	0.9	296	33.2	402	274	7.9	402
	7	46	81	0	127	6.2	0.5	331	36.2	127	284	7.5	127
	8	108	80	0	188	9.2	0.6	383	37.9	188	296	6.1	188
	9	228	183	0	411	20.2	0.9	413	38.2	411	303	5.2	411
	10	187	217	0	404	19.9	0.9	457	46.6	404	314	6.5	404
	11	61	63	0	124	6.1	0.5	493	48.4	124	321	6.9	124
11-20 May	12	30	30	0	60	3.0	0.4	529	62.0	60	330	7.4	60
	13	6	6	0	12	0.6	0.2	541	43.4	12	330	6.4	12
	14	11	9	0	20	1.0	0.2	557	56.3	20	334	8.5	20
	15	5	5	0	10	0.5	0.2	544	47.6	10	336	7.2	10
	16	0	3	0	3	0.1	0.1	623	41.0	3	350	10.7	3
	17	1	1	0	2	0.1	0.1	538	42.4	2	338	0.7	2
	18	1	1	0	2	0.1	0.1	530	26.2	2	341	6.4	2
	19												
	20	0	1	0	1	0.0	0.0	592		1	338		1
All Samples Combined		1,009	1,024	0	2,033	100.0		379	98.5	2,033	294	23.8	2,033
Sex Composition		49.6	50.4										
Unaged		130	142	0	272	13.4		403	95.6	272	300	22.1	272
Sex Composition		47.8	52.2										

Appendix B6.–Age, sex and size composition of Pacific herring caught by commercial gillnet, Kulukak Section, 13 May to 18 May, 2007.

Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	6	1	0	0	1	0.9	1.2	355		1	283		1
	6	1	1	0	2	3.3	2.3	352	15.6	2	283	2.1	2
	7												
13-May	8	4	1	0	5	8.2	3.5	411	11.3	5	300	4.2	5
	9	9	7	0	16	26.2	5.7	420	27.2	16	306	5.4	16
	10	11	18	0	29	47.5	6.4	470	46.1	29	315	5.3	29
	11	2	4	0	6	9.8	3.8	479	23.1	6	320	7.2	6
	12	1	2	0	3	4.9	2.8	548	8.5	3	337	4.0	3
Sample Total		28	33	0	61	100.0		453	51.6	61	312	10.8	61
	7	0	3	0	3	3.3	1.9	367	37.4	3	290	14.6	3
	8	4	5	0	9	9.8	3.1	388	33.5	9	296	6.8	9
	9	14	19	0	33	35.9	5.0	419	26.7	33	305	4.9	33
14-May	10	28	10	0	38	41.3	5.2	454	45.3	38	316	7.0	38
	11	4	1	0	5	5.4	2.4	459	57.6	5	322	7.3	5
	12	2	2	0	4	4.3	2.1	554	83.9	4	336	7.8	4
Sample Total		52	40	0	92	100.0		437	53.4	92	310	11.7	92
	6	0	1	0	1	1.3	1.3	300		1	270		1
	7	1	1	0	2	2.6	1.8	372		2	293	7.8	2
	8	4	5	0	9	11.8	3.7	401	30.5	9	301	3.7	9
	9	12	14	0	26	34.2	5.5	421	41.3	26	305	6.5	26
15-May	10	8	20	0	28	36.8	5.6	449	40.7	28	313	4.7	28
	11	1	3	0	4	5.3	2.6	483	43.5	4	319	4.3	4
	12	2	2	0	4	5.3	2.6	470	18.4	4	321	1.3	4
	13												
	14	1	1	0	2	2.6	1.8	574	86.3	2	331	14.1	2
Sample Total		29	47	0	76	100.0		436	52.7	76	309	10.0	76
	6	2	4	0	6	5.2	2.1	332	25.8	6	279	5.2	6
	7	1	3	0	4	3.5	1.7	346	16.8	4	287	2.1	4
	8	7	2	0	9	7.8	2.5	390	20.8	9	299	6.0	9
	9	20	23	0	43	37.4	4.5	411	33.3	43	304	6.2	43
	10	19	22	0	41	35.7	4.5	452	42.6	41	315	6.1	41
18-May	11	2	4	0	6	5.2	2.1	512	29.7	6	322	5.7	6
	12	3	0	0	3	2.6	1.5	543	37.8	3	336	10.8	3
	13	1	0	0	1	0.9	0.9	499		1	333		1
	14	0	1	0	1	0.9	0.9	580		1	335		1
	15												
	16	1	0	0	1	0.9	0.9	422		1	313		1
Sample Total		56	59	0	115	100.0		428	57.3	115	308	12.8	115

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Sample Dates	Age	Sex (number) Male	Female	Unk.	Total	Percent of Total	SE	Weight Mean (g)	SD	Number Weighed	Length Mean (mm)	SD	Number Measured
	6	3	6	0	9	2.6	0.9	333	25.9	9	279	5.5	9
	7	2	7	0	9	2.6	0.9	359	24.7	9	289	8.3	9
	8	19	13	0	32	9.3	1.6	396	27.0	32	299	5.6	32
	9	55	63	0	118	34.3	2.6	417	32.8	118	305	5.8	118
	10	66	70	0	136	39.5	2.6	456	44.0	136	315	6.0	136
	11	9	12	0	21	6.1	1.3	484	41.1	21	321	6.0	21
13-18 May	12	8	6	0	14	4.1	1.1	526	57.7	14	332	9.4	14
	13	1	0	0	1	0.3	0.3	499		1	333		1
	14	1	2	0	3	0.9	0.5	576	61.1	3	332	10.3	3
	15												
	16	1	0	0	1	0.3	0.3	422		1	313		1
All Samples Combined		165	179	0	344	100.0		437	54.7	344	309	11.6	344
Sex Composition		48.0	52.0										
Unaged		33	27	0	60	17.4		441	57.9	60	312	12.7	60
Sex Composition		55.0	45.0										

Appendix B7.–Age, sex and size composition of Pacific herring caught by test purse seine, Togiak Section, 22 May, 2007.

| Sample Dates | Age | Sex (number) | | | | Percent of Total | SE | Weight | | | Length | | |
		Male	Female	Unk.	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	5	10	13	0	23	15.4	3.0	205	32.7	23	254	13.5	23
	6	20	9	0	29	19.5	3.3	245	28.7	29	272	10.4	29
	7	4	5	0	9	6.0	2.0	266	32.0	9	280	8.8	9
	8	11	12	0	23	15.4	3.0	327	26.6	23	297	6.4	23
22-May	9	14	14	0	28	18.8	3.2	342	32.4	28	302	6.0	28
	10	8	20	0	28	18.8	3.2	378	20.3	28	314	6.0	28
	11	3	2	0	5	3.4	1.5	377	34.0	5	313	10.1	5
	12	2	1	0	3	2.0	1.2	458	21.5	3	331	2.6	3
	13												
	14	0	1	0	1	0.7	0.7	445		1	351		1
All Samples Combined		72	77	0	149	100.0		306	72.4	149	290	23.8	149
Sex Composition		48.3	51.7										
Unaged		12	9	0	21	14.1		326	78.2	21	295	27.0	21
Sex Composition		57.1	42.9										

Appendix B8.–Age, sex and size composition of Pacific herring caught by commercial purse seine at Hagemeister, Nunavachak, Pyrite Point, and Togiak Sections, 11 May to 16 May, 2007 used to estimate the inseason biomass.

Sample Dates	Age	Male	Female	Unk.	Total	Percent of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
			Sex (number)					Weight			Length		
	4	1	0	0	1	0.3	0.3	172		1	232		1
	5	9	7	0	16	5.6	1.4	243	29.0	16	258	6.2	16
	6	13	25	0	38	13.2	2.0	300	26.7	38	273	7.3	38
	7	9	13	0	22	7.6	1.6	337	42.4	22	283	7.8	22
	8	18	9	0	27	9.4	1.7	387	30.5	27	294	5.2	27
	9	37	29	0	66	22.9	2.5	428	33.1	66	303	5.4	66
	10	32	41	0	73	25.3	2.6	471	36.4	73	313	5.6	73
	11	13	12	0	25	8.7	1.7	515	47.6	25	320	7.7	25
11-May	12	4	8	0	12	4.2	1.2	555	37.7	12	330	6.4	12
	13	1	1	0	2	0.7	0.5	550	12.7	2	331	3.5	2
	14	2	1	0	3	1.0	0.6	591	21.1	3	339	6.2	3
	15	0	1	0	1	0.3	0.3	621		1	345		1
	16	0	1	0	1	0.3	0.3	670		1	348		1
	17	1	0	0	1	0.3	0.3	568		1	338		1
	18												
	19												
	20												
Sample Total		140	148	0	288	100.0		418	93.7	288	300	20.9	288
	4												
	5	5	6	0	11	4.1	1.2	254	30.6	11	261	6.5	11
	6	28	32	0	60	22.1	2.5	307	29.6	60	276	6.7	60
	7	10	16	0	26	9.6	1.8	342	33.7	26	286	7.5	26
	8	14	13	0	27	10.0	1.8	390	35.9	27	296	6.0	27
	9	28	32	0	60	22.1	2.5	415	35.2	60	302	4.2	60
	10	26	36	0	62	22.9	2.6	474	47.8	62	316	6.4	62
	11	10	8	0	18	6.6	1.5	480	32.4	18	319	6.5	18
12-May	12	1	0	0	1	0.4	0.4	471		1	322		1
	13	0	1	0	1	0.4	0.4	561		1	331		1
	14	1	2	0	3	1.1	0.6	604	25.0	3	339	10.3	3
	15	1	0	0	1	0.4	0.4	525		1	332		1
	16	0	1	0	1	0.4	0.4	601		1	362		1
	17												
	18												
	19												
	20												
Sample Total		124	147	0	271	100.0		397	83.2	271	298	19.1	271
	4	1	6	0	7	2.0	0.8	184	17.5	7	239	3.5	7
	5	18	20	0	38	11.1	1.7	241	33.2	38	259	10.4	38
	6	20	36	0	56	16.4	2.0	300	35.2	56	274	8.4	56
	7	7	16	0	23	6.7	1.4	311	27.9	23	281	6.4	23
	8	20	17	0	37	10.8	1.7	395	33.0	37	298	5.8	37
	9	47	40	0	87	25.4	2.4	414	39.3	87	304	5.5	87
	10	23	30	0	53	15.5	2.0	459	44.2	53	314	6.8	53
	11	7	6	0	13	3.8	1.0	494	50.9	13	322	5.7	13
13-May	12	10	9	0	19	5.6	1.2	539	70.3	19	331	9.3	19
	13	3	2	0	5	1.5	0.7	548	23.3	5	329	4.0	5
	14	0	2	0	2	0.6	0.4	601	90.5	2	341	14.8	2
	15	0	2	0	2	0.6	0.4	584	26.9	2	344	4.9	2
	16												
	17												
	18												
	19												
	20												
Sample Total		156	186	0	342	100.0		383	100.1	342	295	23.7	342

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Sample Dates	Age	Male	Female	Unk.	Total	Percent of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	4	2	2	0	4	1.2	0.6	169	15.2	4	235	3.5	4
	5	11	8	0	19	5.8	1.3	245	29.7	19	258	9.6	19
	6	26	27	0	53	16.2	2.0	294	32.2	53	274	8.7	53
	7	4	16	0	20	6.1	1.3	342	36.9	20	286	9.3	20
	8	15	11	0	26	7.9	1.5	376	48.7	26	294	6.1	26
	9	47	27	0	74	22.6	2.3	402	39.0	74	304	5.8	74
	10	38	46	0	84	25.6	2.4	451	50.1	84	314	7.9	84
	11	13	15	0	28	8.5	1.5	500	56.7	28	322	8.7	28
14-May	12	5	5	0	10	3.0	0.9	511	54.2	10	331	4.4	10
	13	0	1	0	1	0.3	0.3	575		1	346		1
	14	1	1	0	2	0.6	0.4	537	37.5	2	324	0.7	2
	15	3	1	0	4	1.2	0.6	514	35.5	4	332	6.7	4
	16	0	1	0	1	0.3	0.3	597		1	341		1
	17												
	18	0	1	0	1	0.3	0.3	511		1	336		1
	19												
	20	0	1	0	1	0.3	0.3	592		1	338		1
Sample Total		165	163	0	328	100.0		395	91.9	328	300	22.2	328
	4	1	1	0	2	1.1	0.8	168	7.8	2	234	0.7	2
	5	12	10	0	22	12.0	2.4	249	22.0	22	259	7.0	22
	6	17	27	0	44	23.9	3.2	295	33.4	44	272	6.7	44
	7	4	6	0	10	5.4	1.7	343	29.3	10	283	5.6	10
	8	12	10	0	22	12.0	2.4	380	38.6	22	294	6.8	22
	9	22	14	0	36	19.6	2.9	407	36.4	36	302	5.0	36
	10	17	11	0	28	15.2	2.7	450	42.0	28	314	5.0	28
	11	1	7	0	8	4.3	1.5	504	41.4	8	321	5.0	8
15-May	12	5	0	0	5	2.7	1.2	492	53.5	5	328	7.2	5
	13	1	0	0	1	0.5	0.5	419		1	321		1
	14	3	1	0	4	2.2	1.1	539	30.0	4	331	6.3	4
	15	0	1	0	1	0.5	0.5	572		1	331		1
	16												
	17												
	18	1	0	0	1	0.5	0.5	548		1	345		1
	19												
	20												
Sample Total		96	88	0	184	100.0		370	91.1	184	291	23.0	184
	4	1	2	0	3	2.0	1.2	213	39.3	3	248	15.0	3
	5	18	15	0	33	22.1	3.4	234	33.8	33	252	10.4	33
	6	23	20	0	43	28.9	3.7	303	32.4	43	276	8.3	43
	7	3	4	0	7	4.7	1.7	313	44.0	7	280	7.1	7
	8	4	4	0	8	5.4	1.9	378	32.9	8	296	5.4	8
	9	13	11	0	24	16.1	3.0	414	37.6	24	304	4.8	24
	10	9	11	0	20	13.4	2.8	450	49.2	20	315	6.2	20
	11	3	3	0	6	4.0	1.6	470	58.2	6	321	3.9	6
16-May	12	2	3	0	5	3.4	1.5	500	66.7	5	327	8.3	5
	13												
	14												
	15												
	16												
	17												
	18												
	19												
	20												
Sample Total		76	73	0	149	100.0		341	94.1	149	285	25.6	149

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| Sample Dates | Age | Sex (number) | | | | Percent of Total | SE | Weight | | | Length | | |
		Male	Female	Unk.	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	4	6	11	0	17	1.1	0.3	183	24.8	17	239	7.7	17
	5	73	66	0	139	8.9	0.7	242	30.8	139	257	9.5	139
	6	127	167	0	294	18.8	1.0	300	31.9	294	274	7.8	294
	7	37	71	0	108	6.9	0.6	332	37.1	108	284	7.7	108
	8	83	64	0	147	9.4	0.7	386	37.2	147	296	6.1	147
	9	194	153	0	347	22.2	1.1	414	37.7	347	303	5.3	347
	10	145	175	0	320	20.5	1.0	461	45.9	320	314	6.6	320
	11	47	51	0	98	6.3	0.6	498	49.6	98	321	7.2	98
11-16 May	12	27	25	0	52	3.3	0.5	528	60.7	52	330	7.4	52
	13	5	5	0	10	0.6	0.2	539	46.1	10	330	6.9	10
	14	7	7	0	14	0.9	0.2	573	45.6	14	335	9.3	14
	15	4	5	0	9	0.6	0.2	549	47.6	9	336	7.6	9
	16	0	3	0	3	0.2	0.1	623	41.0	3	350	10.7	3
	17	1	0	0	1	0.1	0.1	568		1	338		1
	18	1	1	0	2	0.1	0.1	530	26.2	2	341	6.4	2
	19												
	20	0	1	0	1	0.1	0.1	592		1	338		1
All Samples Combined		757	805	0	1,562	100.0		389	95.0	1,562	296	22.7	1,562
Sex Composition		48.5	51.5										
Unaged		97	106	0	203	13.0		419	91.4	203	303	20.5	203
Sex Composition		47.8	52.2										

Appendix B9.–Age, sex and size composition of Pacific herring caught by commercial purse seine at Hagemeister and Pyrite Point Sections, 18 May to 20 May, 2007 used to estimate the postseason biomass.

Sample Dates	Age	Male	Female	Unk.	Total	Percent of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
			Sex (number)					Weight			Length		
	4	2	3	0	5	3.0	1.3	184	19.6	5	240	7.8	5
	5	11	13	0	24	14.2	2.7	252	34.0	24	261	9.2	24
	6	23	17	0	40	23.7	3.3	290	36.0	40	275	7.5	40
	7	2	2	0	4	2.4	1.2	351	24.0	4	291	3.9	4
	8	7	5	0	12	7.1	2.0	364	45.6	12	297	7.5	12
	9	13	9	0	22	13.0	2.6	399	41.3	22	305	5.0	22
18-May	10	21	22	0	43	25.4	3.4	433	43.1	43	314	6.0	43
	11	3	5	0	8	4.7	1.6	473	49.2	8	324	6.3	8
	12	2	3	0	5	3.0	1.3	531	57.0	5	332	7.1	5
	13	1	1	0	2	1.2	0.8	548	38.9	2	331	4.9	2
	14	3	0	0	3	1.8	1.0	493	29.5	3	332	4.2	3
	15												
	16												
	17	0	1	0	1	0.6	0.6	508		1	337		1
Sample Total		88	81	0	169	100.0		362	95.8	169	294	25.2	169
	4	5	2	0	7	3.3	1.2	181	17.7	7	242	6.7	7
	5	34	28	0	62	29.5	3.2	224	27.8	62	255	9.4	62
	6	26	21	0	47	22.4	2.9	283	29.8	47	274	8.6	47
	7	5	6	0	11	5.2	1.5	312	27.3	11	282	5.8	11
	8	10	5	0	15	7.1	1.8	382	32.8	15	297	5.1	15
19-May	9	15	10	0	25	11.9	2.2	402	33.5	25	302	4.3	25
	10	10	15	0	25	11.9	2.2	458	54.6	25	315	6.3	25
	11	9	5	0	14	6.7	1.7	478	39.0	14	321	5.2	14
	12	1	0	0	1	0.5	0.5	431		1	321		1
	13												
	14	1	2	0	3	1.4	0.8	550	88.2	3	333	9.6	3
	15												
	16												
	17												
Sample Total		116	94	0	210	100.0		323	103.4	210	282	26.0	210
	4	0	3	0	3	3.3	1.9	150	15.0	3	224	2.1	3
	5	7	3	0	10	10.9	3.3	227	39.6	10	254	9.8	10
	6	11	10	0	21	22.8	4.4	275	38.3	21	270	8.2	21
	7	2	2	0	4	4.3	2.1	337	26.8	4	289	4.0	4
	8	8	6	0	14	15.2	3.8	368	38.9	14	295	5.0	14
20-May	9	6	11	0	17	18.5	4.1	423	44.9	17	304	6.1	17
	10	11	5	0	16	17.4	4.0	443	36.6	16	312	4.5	16
	11	2	2	0	4	4.3	2.1	470	26.7	4	319	6.0	4
	12	0	2	0	2	2.2	1.5	616	22.6	2	337	0.0	2
	13												
	14												
	15	1	0	0	1	1.1	1.1	499		1	338		1
	16												
	17												
Sample Total		48	44	0	92	100.0		357	102.8	92	289	25.6	92

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Appendix B9.–Page 2 of 2.

| Sample Dates | Age | Sex (number) | | | | Percent of Total | SE | Weight | | | Length | | |
		Male	Female	Unk.	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	4	7	8	0	15	3.2	0.8	176	21.3	15	237	9.2	15
	5	52	44	0	96	20.4	1.9	231	32.6	96	256	9.7	96
	6	60	48	0	108	22.9	1.9	284	34.0	108	274	8.2	108
	7	9	10	0	19	4.0	0.9	326	30.3	19	285	6.5	19
	8	25	16	0	41	8.7	1.3	372	38.7	41	296	5.8	41
18-20 May	9	34	30	0	64	13.6	1.6	407	40.1	64	303	5.1	64
	10	42	42	0	84	17.8	1.8	443	46.5	84	314	5.9	84
	11	14	12	0	26	5.5	1.1	475	39.5	26	322	5.7	26
	12	3	5	0	8	1.7	0.6	540	73.1	8	332	7.3	8
	13	1	1	0	2	0.4		548	38.9	2	331	4.9	2
	14	4	2	0	6	1.3	0.5	522	66.7	6	332	6.7	6
	15	1	0	0	1	0.2	0.2	499		1	338		1
	16						0.0						
	17	0	1	0	1	0.2	0.2	508		1	337		1
All Samples Combined		252	219	0	471	100.0		344	102.1	471	288	26.1	471
Sex Composition		53.5	46.5										
Unaged		33	36	0	69	14.6		358	93.6	69	291	24.1	69
Sex Composition		47.8	52.2										

APPENDIX C

ALASKA DEPARTMENT OF

FISH & GAME

DIVISION OF COMMERCIAL FISHERIES

NEWS RELEASE

2007 Togiak Herring Forecast

ISSUED: November 8, 2006

The 2007 Togiak herring forecast and harvest allocation is listed below for the Togiak District sac roe fishery and the Dutch Harbor food and bait fishery, given a maximum 20% exploitation rate of the projected run biomass:

Harvest Allocation of the 2007 Forecasted Pacific

Herring Run Biomass, Togiak District, Bristol Bay

	Biomass (Short Tons)	Harvest (Short Tons)
Forecasted Biomass for 2007	134,566	
Exploitation @ maximum 20% for Total Allowable Harvest		26,913
Togiak Spawn-on-Kelp Fishery (Fixed Allocation)		1,500

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Remaining Allowable Harvest	25,413
Dutch Harbor Food/Bait Allocation	
(7.0% of the remaining allocation)	1,779
Remaining Allowable Harvest for	
Togiak District Sac Roe Fishery:	23,634
Purse Seine Allocation 70.0%	16,544
Gill Net Allocation 30.0%	7,090

2007 Togiak Herring Forecast Summary

The Pacific herring population is forecast to be 134,566 tons in the Togiak District during 2007 (Figure 1). Herring returning from the 1996, 1997 and 1998-year classes (Age-11, -10 and -9, respectively) are expected to comprise 59.6% of the biomass. Age-10 herring are expected to make up 28.5% of the biomass, followed by age-9 (16.6%) and age-11 (14.5%; Figure 2). The remainder of the herring population is expected to be comprised of ages 4-5 (13.7%), ages 6-8 (22.9%) and ages 12-15 (3.9%) fish. The forecasted individual average weight of herring in the harvest biomass is 390 g.

We used an age-structured analysis (ASA) model to forecast the Togiak herring population using catch and age composition data and aerial survey biomass estimates. The ASA model integrated data from purse seine fishery age compositions (1978-2006), total run age compositions (1978-1995, 1997, 1999, 2001, 2005, and 2006), and aerial survey biomass estimates (1981, 1983, 1992-1994, 1997, 1999-2001, 2005, and 2006). Model estimates were generated and compared to observed data. Samples from non-selective gear (commercial purse seine and test purse seine) were used to assess the age composition of the total run biomass. Commercial purse seine catch and test fish samples ranged from age-3 to age-18. Age-4 herring abundance and weight was predicted using the recent four year average. Simple linear regression models were used to forecast the weight of age-5 through age-15 herring based on their weight the previous year.

A temporal change in age composition from older to younger herring typically occurs in the fishery. Age-8, -9, and -10 herring predominated, comprising 66.0% of the total commercial purse seine harvest. As the season progressed younger age-4 and -5 herring began to comprise a larger portion of the daily commercial purse seine harvest. This may signify the beginning of a recruitment event. However, assessing younger age classes of herring is difficult as they typically do not show up until the later part or after the fishery. In addition, we no longer conduct post-fishery sampling that occurred during the 1980s.

The Togiak District herring biomass was estimated to be 176,288 tons in 2006. This was the sum of the peak biomass aerial survey estimate of 124,711 (tons) observed 13 May, and the aerial biomass estimate of 51,577 (tons) observed 26 May. Herring were first reported in the district on 9 May, when approximately 202 tons were documented. The peak biomass was observed on 13 May with a majority of the estimated 124,711 tons concentrated in Hagemeister and Togiak sections. Biomass of the Togiak herring spawning population has been estimated with aerial surveys since the late 1970's, concurrent with the development of the sac-roe fishery. Large recruitment events have been observed approximately every eight to ten years in the Togiak herring population with the most recent events occurring from the 1996 and 1997-year classes.

There is always uncertainty in forecasting the Togiak District herring biomass and predicting the 2007 return is no different than pervious years. Since its inception in 1993, the performance of the ASA model has had a tendency to be biased low. The mean percent error (MPE) was –28% for years with reliable total run biomass estimates (Figure 1). The accuracy or mean absolute percent error (MAPE) of the ASA model has been 25%. We are currently looking into why the forecasts from the ASA model have a tendency to be biased low. In addition, we will continue to work on improving our ability to forecast the Togiak herring population. We consider the Togiak herring population to be healthy and sustainable.

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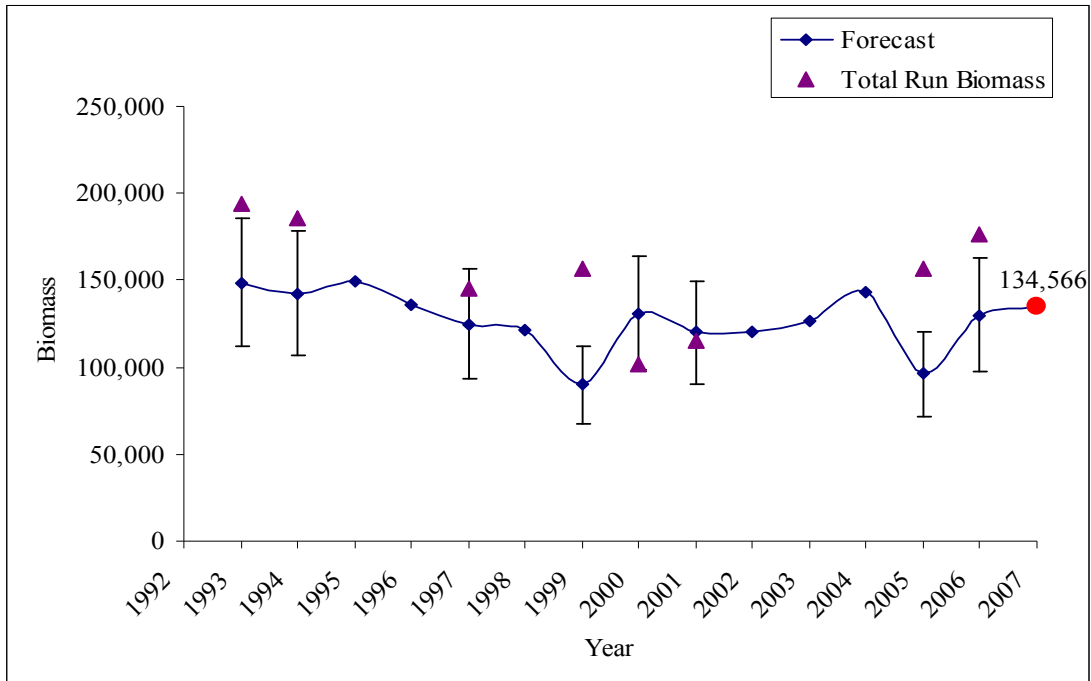
Bristol Bay Research Staff

Anchorage

Figure 1.–Observed Togiak herring total run biomass estimates and previous preseason forecasts based on the ASA model. Mean absolute percent error (MAPE) of 25% around the forecast is also shown for years with a reliable total run biomass estimate.
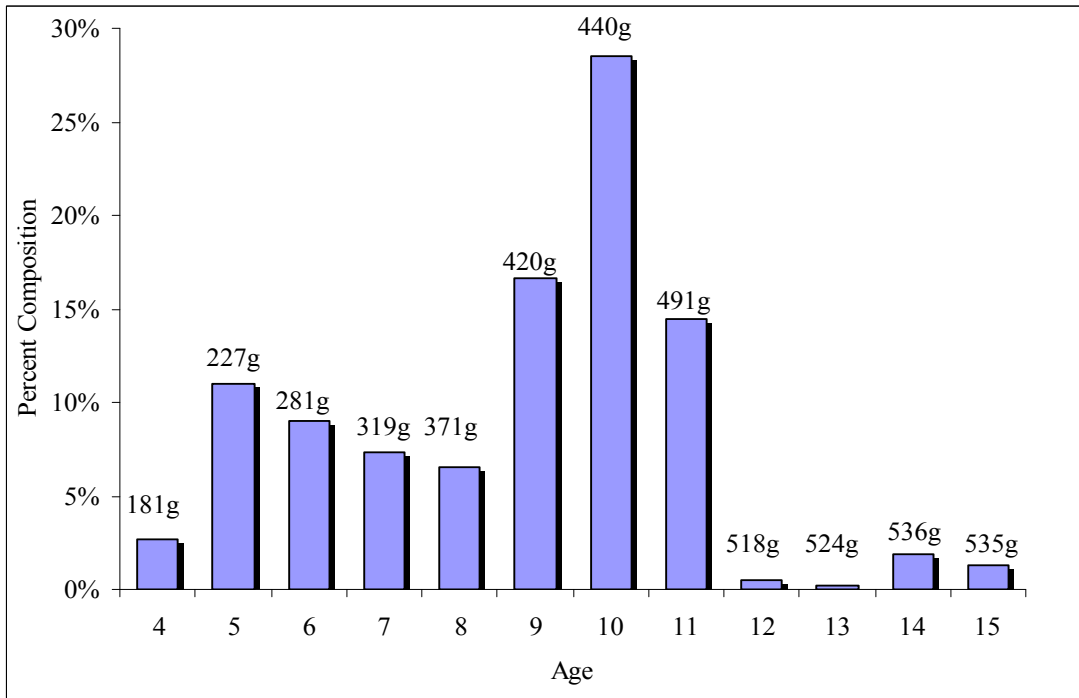

Figure 2.–Forecasted age composition by weight and number for the 2007 Togiak herring return. Forecasted average weight (grams) by age is also presented.